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Readings on Managing Organizational Quality

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(Coeditors)

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READINGS ON MANAGING ORGANIZATIONAL QUALITY

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13. ABSTRACT (Maximum 200 words) This volume of readings has been compiled for those interested in learning about new management philosophies that are helping to bring about the transformation of American industry and that are enabling firms to meet competitive challenges successfully with novel strategies. The new management philosophy is based on assumptions that better reflect the ground rules of today's global economy than do the assumptions upon which much of current management practice is based. This set of readings emphasizes the role of leadership at various levels of the organization in bringing about effective organizational response to the new competitive challenge. It describes changes in policies, in organizational structure, in the management of relationships with customers and suppliers, and in the management of relationships within organizations that will help them to create and sustain competitive advantage. Several articles make explicit old working assumptions and suggest new ones to replace them.					
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FOREWORD

This volume of readings on managing quality improvement is being published under the auspices of the Quality Support Center (QSC), Navy Personnel Research and Development Center (NPRDC). The QSC was chartered by the Department of Navy's (DON) Executive Steering Group for Total Quality Management (TQM) in April 1990, and tasked with providing three important services to the Navy--a clearinghouse, education and consultation, and training and development of TQM managers in specific commands. This product was sponsored by the Office of the Under Secretary of the Navy and funded under Operations and Maintenance, Navy (O&M,N), Work Unit No. 98-9P0C0012.

This current set of readings on quality improvement is the third such volume to be published by NPRDC. Unlike the first two, which focused on definitions of quality and implementation issues (Technical Notes 87-23 and 89-17, respectively), this volume addresses issues aimed at organizational transformation. It focuses on the overriding management and leadership issues that need to be the cornerstone of TQM efforts in the Department of Defense (DOD) and DON in order to make substantial improvements in major systems and maintain a strong position in defense of the nation.

The intended audience for this set of readings are the managers and leaders of the DOD and the DON and those individuals tasked with assisting in the transformation. While methods and tools for process improvement are important, the contributors to this volume recognize that these tools will not have much impact on major organizational change without top leadership's commitment. (Readers who have not been exposed to analyses procedures are directed to Section V in this report for articles on the use of statistical tools to guide improvement efforts.)

This book of readings is unique in that it brings together from a wide variety of sources some of the important concepts in managing organizational change. It reflects the emphasis of the Organizational Systems Department, NPRDC, that the tools and methods of process analysis and improvement need to be integrated with the leadership requirements for organizing and planning for quality and with the research findings from organizational change literature. These concepts are central to the planned organizational change approach that this department has advocated for a number of years in its productivity and quality enhancement research efforts in field and headquarters military organizations.

Some further comments on this volume of readings:

First, articles were selected by the editors that were consistent with the philosophy of W. Edwards Deming. This guideline was followed because NPRDC has been

incorporating the leadership obligations that Deming has advocated into its development of TQM concepts and implementing strategy that serve as the basis of NPRDC's research and consultation work for the past 6 years. Moreover, the DON recently adopted the Deming approach to improving quality. While Deming's work may not be referenced in some of these articles, they have been included because of their support of his philosophy.

Second, researchers in this department have been conducting work on productivity and organizational change for almost 15 years and have come to recognize the importance of specific leadership requirements if any significant improvements are to occur. These requirements are specified in the Metz article, and even though this article has been included in previous collections, its importance is such that it is worthwhile to revisit.

Third, several sections of this volume are dedicated to crucial leadership concerns that have significance for managers within DOD and DON. A number of articles address organizational transformation, what researchers at NPRDC call "second phase" transformation. This phase can occur only after the work of the "first phase" is done, that is, when there are *enough people* with the *right knowledge* to initiate and sustain the changes required to practice the "total quality" concept.

In line with the notion of "second phase" transformation, Section VI focuses on reward systems in organizations and their impact on individual and organizational performance. An essential ingredient for organizational change is to understand the negative impact that competition among employees plays on quality and productivity. Alfie Kohn presents compelling arguments for organization-wide cooperation, and the article should serve as the basis for designing a phase two organization.

Fourth, organizational transformation will also require that accounting principles be revolutionized to provide data useful to process improvement efforts. While research in this area has not yet become prolific, revamping of accounting systems has far-reaching implications for acquisition management within DOD and DON. The interview in Section VII describes the faults with existing systems and makes recommendations for improvements.

Permission to reprint the articles in this collection has been generously granted to NPRDC by the various publishers. However, permission to reprint them has been obtained for NPRDC only. Point of contact at NPRDC concerning this technical note is Mr. Harold H. Rosen, Quality Support Center, (619) 553-7952 (AUTOVON 553-7952).

RICHARD C. SORENSON
Technical Director (Acting)

PREFACE

Arnold Toynbee once described the rise and fall of nations in terms of challenge and response. A young nation, he said, is confronted with a challenge for which it finds a successful response. It then grows and prospers. But as time passes, the nature of the challenge changes. And if a nation continues to make the same, once-successful response to the new challenge, it inevitably suffers a decline and eventual failure. As we begin the last two decades of the 20th century, the United States faces such a challenge.

William S. Anderson
Chairman, NCR Corporation

Business organizations are facing a change more extensive, more far-reaching in its implications, and more fundamental in its transforming quality than anything since the modern industrial system took shape in the years from roughly 1890 and 1920.¹ The business practices developed in this time period and the strategic management principles developed in the post-War era, a unique period in U.S. business history, are no longer sufficient to maintain American competitiveness.²

The competitive playing field, heavily in favor of the U.S. after the Second World War, has been leveled. Today, production capacity exists in many countries, technology spreads rapidly, and materials are available for purchase throughout the world. The slack enjoyed by companies in the post-War era has been eroded by the development of new production techniques and management practices by new competitors. Leadership, management practice, education, and investment in the development of people are beginning to determine the competitiveness of firms and countries to a greater extent than ever before.

This volume of readings has been compiled for those interested in learning about new management philosophies that are helping to bring about the transformation of American industry and that are enabling firms to meet

¹Nelson, D. (1975). Managers and workers: Origins of the new factory system in the U.S. 1880-1920. Madison, WI: University of Wisconsin Press.

²Mitroff, I. (1988). Business not as usual: Rethinking our individual, corporate, and industrial strategies for global competition. San Francisco, CA: Joey Bass.

competitive challenges successfully with novel strategies. The new management philosophy is based on assumptions that better reflect the ground rules of today's global economy than do the assumptions upon which much of current management practice is based.

This set of readings emphasizes the role of leadership at various levels of the organization in bringing about effective organizational response to the new competitive challenge. It also describes changes in policies, in organizational structure, in the management of relationships with customers and suppliers, and in the management of relationships within organizations that will help them to create and to sustain competitive advantage. Several articles help the reader to understand the necessity for a new management philosophy by making explicit old working assumptions for management and suggesting new ones to replace them.

In the new management philosophy, change comes about through the understanding, analysis, and improvement of organizational processes--in manufacturing, service, or administrative areas. The process of improvement requires the use of new types of information and data; therefore, this set of readings also describes some of the tools used for gathering and for analyzing such information. Finally, a few case studies illustrate some organizational transformation efforts. These examples are drawn from service and administrative areas, which are potentially a source of great improvement in cost, productivity, and quality, but are often ignored in organizational transformation efforts in manufacturing firms.

The organization of this set of readings is as follows. The lead article summarizes a study conducted at M.I.T. on the state of American industrial competitiveness. Several problems in management practice are described and recommendations are made to improve the competitive position of U.S. firms. The second section contains articles on the successful management of organizational change. The third section contains articles that describe why some current management practices are hampering the competitiveness of U.S. industry and outlines the new management philosophy and its underpinnings. The articles in the fourth section argue that changes in management practice and in the traditional role of leadership are crucial to successful adoption of the new philosophy.

The fifth section introduces the reader to the fundamental idea of a process or system and describes several tools used in the analysis and improvement of organizational processes. The sixth section contains a discussion about some strongly held assumptions about competition and reward systems. Many leading scholars and practitioners of the new management philosophy deem

changes in systems of reward in organizations as a centerpiece of the transformational effort. The article in the seventh section argues that traditional accounting practices no longer provide the type of data or information that is useful in improvement of organizational processes and that revision of these practices would provide decision makers with more appropriate data for strategic decision making. Finally, the last section contains case studies of improvement efforts in the service sector.

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SECTION VI: THE EFFECT OF REWARD SYSTEMS, COOPERATION, AND COMPETITION ON PEOPLE, QUALITY, AND PRODUCTIVITY

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(A debate between Alfie Kohn, author of No Contest: The case against competition [Houghton Mifflin, 1986] and Tom Peters, whose most recent book is Thriving on chaos: Handbook for a management revolution [Knopf, 1987].)

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SECTION I: THE COMPETITIVE STATE OF U.S. INDUSTRY

Berger, S., Dertouzos, M. L., Lester, R. K., Solow, R. M., & Thurow, L. C. (June 1989). Toward a new industrial America. Scientific American, 260(6), 39-47.

The authors of this study are members of the M.I.T. Commission on Industrial Productivity. Their study reveals patterns of weakness in American industry as well as patterns of change that are common to successful U.S. firms.

They found that successful firms emphasized simultaneous improvements in quality, cost, and speed of commercialization. In addition, successful firms were developing closer ties to their customers and more tightly coordinated relations with suppliers. Successful firms are integrating new technology in their manufacturing and marketing strategies rather than throwing new hardware at performance problems. Other practices of successful companies included flattening of steep organizational hierarchies and continuous training of employees to promote responsibility and commitment.

The authors conclude the article with five imperatives for U.S. industry, which they assert has the primary responsibility to correct past problems and find ways to compete successfully in the future. These address investment in human capital, education, changes in tax policy to encourage investment and research, employee involvement, study of the new fundamentals of manufacturing, cooperation among economic entities, and attainment by U.S. industry of a more international outlook, including knowledge of other languages, cultures, market customs, tastes, legal systems, and regulations.

Toward a New Industrial America

A "bottom-up" study of U.S. industrial performance—from the factory floor to the corporate boardroom—by a distinguished group of experts reveals worrisome weaknesses but also encouraging signs of vitality

by Suzanne Berger, Michael L. Dertouzos, Richard K. Lester, Robert M. Solow and Lester C. Thurow

The U.S. economy is a perplexing mix of strengths and weaknesses. It is now in the seventh year of the longest peacetime expansion in this century. Since the early 1980's large numbers of new jobs have been created, and both unemployment and inflation have remained low. American exports have recently surged (helped by a decline in the exchange value of the dollar), and in late 1988 American factories were operating at close to full capacity.

On the negative side, the trade deficit remains formidable (although it is beginning to shrink). In 1988 the U.S. bought about \$120 billion more goods and services from other countries than it could sell overseas. The U.S. automobile and steel industries, which once dominated world commerce, have lost market share both at home and abroad, and newer industries are also struggling. The American presence in the consumer-electronics market, for example, has all but disappeared.

There are other disturbing signs that American industry as a whole is not producing as well as it ought to produce or as well as the industries of other nations have learned to produce. Growth in productivity, a crucial indicator of industrial performance, has averaged only slightly more than 1 percent per year since the early 1970's. Productivity has grown more rapidly in several Western European and Asian nations, and U.S. firms are increasingly perceived to be doing poorly in comparison with their foreign competitors in such key aspects as the cost and quality of their products as well as the speed with

which new products are brought to market. In many new fields with broad commercial applications, such as advanced materials and semiconductors, America's best technology may already have been surpassed.

In spite of such disquieting developments, some observers maintain that there is nothing fundamentally wrong with American industry itself. The trade deficit, in this view, is the result not of intrinsic deficiencies in industrial performance but rather of such macroeconomic factors as natural differences in rates of economic growth among countries, fluctuations in currency-exchange rates and the enormous U.S. budget deficit. Then, too, the rise and fall of industries is said to be a normal part of economic evolution; at any given time a certain number of industries are sure to be in decline while others are growing.

Yet if the unfavorable trends in industrial performance are real (and we believe they are), then the U.S. has reason to worry. Americans must produce well if Americans are to live well. The sluggish growth in U.S. productivity is barely sufficient to sustain an improvement in the nation's standard of living. (Real wage rates have in fact hardly increased since the early 1970's.) That, in itself, would be of concern regardless of what is happening in the rest of the world. As it is, the more dynamic productivity performance of other countries is also resulting in a relative decline in the U.S. standard of living. Moreover, because political and military power depend ultimately on economic vitality, weaknesses in the U.S. production system

will inevitably raise doubts about the nation's ability to retain its influence and standing in the world at large.

Late in 1986 the Massachusetts Institute of Technology established the Commission on Industrial Productivity (with funding from the Sloan and Hewlett foundations) to determine whether there actually are pervasive weaknesses in U.S. industrial practices and, if so, to identify their causes and formulate a set of recommendations to counter them. Unlike many observers of contemporary U.S. industry, the commission did not view the problem entirely in macroeconomic terms. We believed that we could best contribute to the understanding of the problem by focusing on the

SUZANNE BERGER, MICHAEL L. DERTOUZOS, RICHARD K. LESTER, ROBERT M. SOLOW and LESTER C. THUROW were among the 16 faculty members of the Massachusetts Institute of Technology who formed the M.I.T. Commission on Industrial Productivity. Berger is professor in the political science department, which she also heads. Dertouzos, who was chairman of the commission, is professor of electrical engineering and computer science; he is also director of the M.I.T. Laboratory for Computer Science. Lester is professor of nuclear engineering and served as the commission's executive director. Solow, who was the commission's vice-chairman, is institute professor in the department of economics. He is the recipient of the 1987 Nobel prize in economics. Thurow is professor of economics and management and dean of the M.I.T. Sloan School of Management.

nation's production system: the organizations, the plants, the equipment and the people—from factory workers to senior executives—that combine to conceive, design, develop, produce, market and deliver products.

In keeping with this "bottom-up" approach, the commission began its task by dividing into eight teams, each of which would examine in detail one of eight manufacturing industries: automobiles; chemicals; commercial aircraft; consumer electronics; machine tools; semiconductors, computers and copiers; steel; and textiles. These industries combined account for 28 percent of U.S. manufacturing output and about half of the total volume of manufactured goods traded by the U.S. (exports and imports). American firms in each industry were evaluated for what we have come to call productive performance: their efficiency, product quality, innovativeness and adaptability, as well as the speed with which they put new products on the market. Such factors are not explicitly captured in conventional measures of industrial productivity. Altogether, the commission's teams visited more than 200 companies and 150 plant sites and conducted nearly 550 interviews in the U.S., Europe and Japan.

In choosing to focus on the production system itself, we did not underestimate the importance of the macroeconomic factors that regulate the economy in the large; on the contrary, we could not avoid observing their manifestations time and again as the teams proceeded with their work. It is clear that the nation's productive performance problems will not be solved without some improvement in the economic environment. The reason is that investment—meant here broadly to include not only new plants, equipment and public works but also education, training and research and development—is crucial for productivity, and the economic environment largely determines the level of a nation's investment. Indeed, we believe that the highest priority of U.S. economic policy must be to reduce the huge federal budget deficit, which saps the savings from which investment funds are drawn.

Nevertheless, after two years of study, it seems clear to us that current economic conditions do not fully explain the deficiencies in U.S. industrial performance, nor will macroeconomic policy changes suffice to cure them. The relation of poor product quality to U.S. interest rates and tax policies, for example, seems at best tenuous. The

economic environment also does not directly affect the speed with which firms identify and respond to changes in the market and to new technological possibilities. Finally, macroeconomics cannot adequately explain why some U.S. businesses thrive in the very same sectors where others are failing, nor why Japanese manufacturing plants in the U.S. have often achieved better results than comparable American plants.

By looking at what actually takes place in industry—from the shop floor to the boardroom—the commission was able to observe recurring patterns of behavior and to draw certain conclusions about the most important micro-level factors that have adversely affected U.S. industrial performance. To do so the commission worked much like a jury: we assessed the large mass of detailed, diverse and sometimes contradictory evidence that the study teams had collected, ultimately reaching a verdict.

The verdict is that U.S. industry indeed shows systematic weaknesses that are hampering the ability of many firms to adapt to a changing international business environment. In particular, the commission observed six such weaknesses: outdated strategies; neglect of human resources; failures of cooperation; technological weaknesses in development and production; government and industry working at cross-purposes; and short time horizons.

The industry studies revealed two types of outdated strategies that are impeding industrial progress today: an overemphasis on mass production of standard commodity goods and an economic and technological parochialism. Both are holdovers from the unique economic environment that prevailed after World War II. For decades after the war U.S. industry was able to flourish by mass-producing undifferentiated goods principally for its own markets, which were large, unified and familiar. Because firms in most other countries had to rebuild in economies devastated by the war, they could mount no significant competition and were largely ignored by U.S. industry.

Not only did U.S. producers sell their wares primarily to the domestic market, they also drew their technical expertise almost exclusively from U.S. factories and laboratories. Such technological parochialism blinded Americans to the growing strength of scientific and technological innovation

abroad and hence to the possibility of adapting foreign discoveries. In the 1950's and 1960's, for example, American steel producers lagged behind Japanese and European steelmakers in adopting such new process technologies as the basic oxygen furnace; later they were again slow to adopt continuous casters and such quality-enhancing technologies as vacuum degassing and oxygen injection. The critical error in many of these cases was the failure to recognize the worth of someone else's innovation.

The American industry of the 1950's and 1960's pursued flexibility by hiring and firing workers who had limited skills rather than by relying on multi-skilled workers. Worker responsibility and input progressively narrowed, and management tended to treat workers as a cost to be controlled, not as an asset to be developed.

Training practices in the U.S. have been consistent with that strategy. Workers often receive limited training while on the job, typically it amounts to watching a colleague at work. Even in firms offering organized training programs, in-plant training is usually short and highly focused on transmitting specific narrow skills for immediate application. In other countries we observed a greater inclination to regard firms as learning institutions, where—through education and training—employees can develop breadth and flexibility in their skills and also acquire a willingness to learn new skills over the long term. In a system based on mass production of standard goods, where cost matters more than quality, the neglect of human resources by companies may have been compatible with good economic performance; today it appears as a major part of the U.S.'s productivity problem.

The neglect of human resources in the U.S. actually begins long before young Americans enter the work force. It is in primary and secondary school that they learn the fundamental skills they will apply throughout life: reading, writing and problem solving. Yet cross-national research on educational achievement shows American children falling behind children in other societies in mathematics, science and language attainment at an early age and falling farther behind as they progress through the school years. The school system—from kindergarten through high school—is leaving large numbers of its graduates without basic skills. Unless the nation begins to remedy these inadequacies in education, real progress in improving

the U.S.'s productive performance will remain elusive.

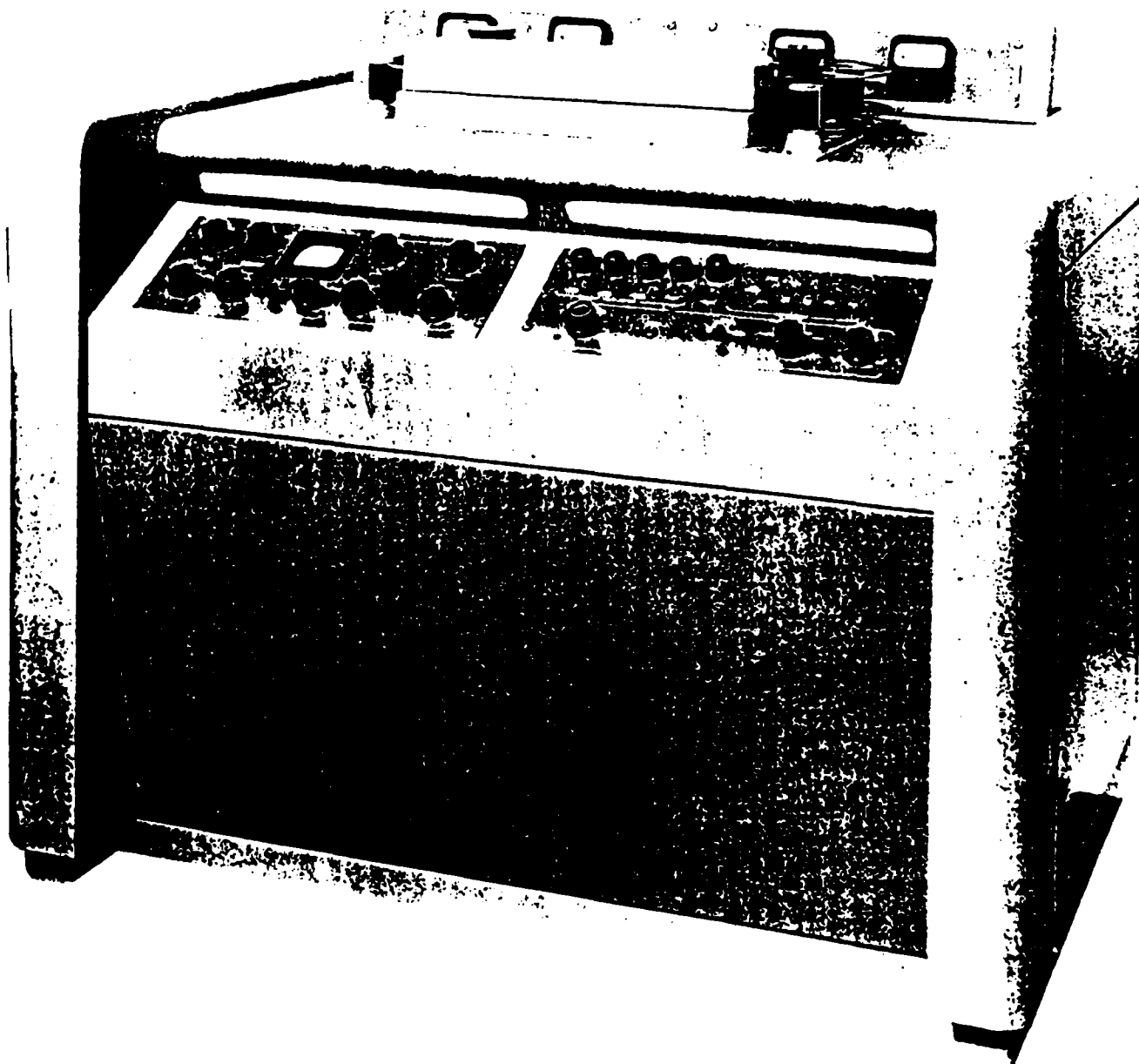
The third recurring weakness of the U.S. production system that emerged from our industry studies is a widespread failure of cooperation within and among companies. In many U.S. firms communication and coordination among departments is often inhibited by steep hierarchical ladders and organizational walls. In addition, labor and management continue to expend valuable resources and energies battling over union organizing.

Suppliers and even customers have

also been kept at arm's length by the management of many U.S. companies, in spite of the fact that such vertical linkages can be conduits not only for raw materials and finished products but also for technological innovations and other developments that enhance productivity. These companies are reluctant to share designs, technologies and strategies with either their customers or their suppliers for fear that proprietary information will leak to competitors. Yet by keeping that kind of information to itself, a firm misses the chance to work with its suppliers

and customers to improve the products it sells and buys. A similar lack of horizontal linkages—cooperative relations between firms in the same industry segment—has led to a dearth of joint projects in such areas as the setting of common standards and industrial research and development, even when they might have been permitted under the law.

Notwithstanding its spotty performance in the global market in recent years, the U.S. remains the world leader in basic research.



FIRST COMMERCIAL VIDEOTAPE RECORDER was made by the Ampex Corporation in Redwood City, Calif., but no U.S. firms were willing or able to devote the resources to bring unit costs down for sale to retail customers. Ampex concentrated on high-price, high-performance systems; other U.S. firms abandoned the field altogether. Japanese companies had the fi-

nancial stamina to sustain low returns on investments while perfecting designs and manufacturing processes. The result is that the Japanese now dominate the consumer video-recording market. Moreover, by capitalizing on the profits, technology and economies of mass production built up in that market, they have begun to encroach on the upscale market as well.

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MEMBERS of the Commission on Industrial Productivity were drawn from the faculty of the Massachusetts Institute of Technology. The interdisciplinary group included economists, technologists and experts on organization, management and politics.

Ironically that outstanding success may have diverted attention from "downstream" technological skills in product and process development and production that become progressively more important as new concepts proceed down the path from the laboratory to the marketplace. Simply put, many U.S. firms have been outperformed in the design and manufacture of reliable, high-quality products.

A survey conducted by the International Motor Vehicle Program (IMVP) at M.I.T. found that, despite recent gains, the number of defects reported in the first three months of use was still almost twice as high for cars produced in American plants in 1986 and 1987 as for those from Japanese plants. The commission's automobile study team also learned that American car builders have recently been taking about five years to carry a new design from the conceptual stage to commercial introduction. In contrast, Japanese manufacturers complete the cycle in three and a half years.

Some of the responsibility for the persistent failure to convert technologies quickly into viable, high-quality products lies in the American system of engineering education, which has deemphasized product realization and process engineering since World War II. The professional norms of the American engineering community also assign rather low priority to

such essential downstream engineering functions as the testing of product designs, manufacturing and product and process improvements.

Other aspects of the problem can be found in certain practices followed by U.S. industry. For one, many American companies simply do not devote enough attention to the manufacturing process. In a recent comparative study of industrial research and development in Japan and the U.S., Edwin Mansfield of the University of Pennsylvania found that U.S. companies are still devoting only a third of their R&D expenditures to the improvement of process technology; the other two thirds is allocated to the development of new and improved products. In Japan those proportions in R&D expenditures are reversed.

Many U.S. companies also fail to coordinate product design and the manufacturing process. It has been standard practice for design engineers to end their involvement with a new product once they have conceived its design. They hand over the design to manufacturing engineers, who are then supposed to come up with a process for the product's manufacture. This compartmentalization of tasks has led to serious problems. Product-design groups often neglect manufacturing considerations, making it harder to come up with a manufacturing process.

The Proprietary project of the Inter-

national Business Machines Corporation is an impressive example of what can be achieved when product designers are brought together with manufacturing engineers and research scientists. Charged with designing a new computer printer that has fewer component parts and no springs or screws (which increase assembly time and decrease reliability), a multidisciplinary IBM design team came up with a product having 60 percent fewer parts than its predecessor. (Ironically because an individual assembly worker could put the printer together in three and a half minutes, the highly automated and expensive assembly plant that had been built to make it was largely rendered superfluous.)

Multifunctional design teams and an orientation toward simplicity and quality at the design stage have been a long-standing fixture of Japanese industry and have contributed to its comparative advantages in quality and productivity. The IMVP survey showed that Japanese-designed automobiles retain their quality advantage even when they are assembled in American factories, which implies that the Japanese automotive engineers had incorporated quality-enhancing features into the design itself.

American companies also have often lagged behind their overseas competitors in exploiting the potential for continual improvement in the quality and reliability of products and processes. The cumulative effect of successive incremental improvements in and modifications of established products and processes can be very large; it may even outpace efforts to achieve technological breakthroughs.

The federal government deserves part of the blame as well for the technological weaknesses in development and production. Whereas the governments of most other industrial nations have purposefully promoted research and technology for economic development, U.S. policy for science and technology has traditionally focused on basic research. The commercial development and application of new technologies have for the most part been considered to be the responsibility of the private sector.

To be sure, the Department of Defense, the National Aeronautics and Space Administration and other federal agencies have invested heavily in technology development. Indeed, about 46 percent of all U.S. research and development is sponsored by the Government. Those expenditures are

usually in the areas of defense and space activities or in other specific Governmental missions, however. In such cases commercial applications of the resulting technology are considered secondarily, if at all. Furthermore, there are indications that defense R&D, which accounts for almost two thirds of all federal R&D spending, is becoming less relevant to the needs of the civilian market.

More generally the lack of a common agenda between government and industry has produced negative effects across broad stretches of the U.S. economy. Some observers, for instance, have blamed the collapse of the consumer-electronics industry in part on the federal government's failure to enact or implement tariffs and import quotas as well as to amend or enforce antidumping and antitrust laws. Yet while some see the problem as too little government support for key industries, others see it as too much government support for inefficient producers.

The evidence gathered from the commission's industry studies was similarly mixed regarding the charge that too much government intervention, particularly in regulating the environment and occupational safety, has put U.S. companies at a disadvantage in relation to foreign competitors. Where problems have arisen, the fault tended to lie in the nature of the regulatory process rather than in the strictness of the regulations themselves. Indeed, many European countries as well as Japan now have environmental and occupational-safety laws in many areas that are at least as strict as those in the U.S.

The issue, then, is not simply whether there is too much government or too little. What is clear to the commission, however, is that a lower level of cooperation between government and business exists in the U.S. than it does in the countries of American firms' major foreign competitors and that the frequency with which government and industry find themselves at cross-purposes is a serious obstacle to strategic and organizational change in individual U.S. firms.

American industry has also been handicapped by shrinking time horizons and a growing preoccupation with short-term profits. There have been many recent instances in which U.S. firms have lost market share to overseas competitors despite an early lead in technology or sales, or both. Often these firms effectively

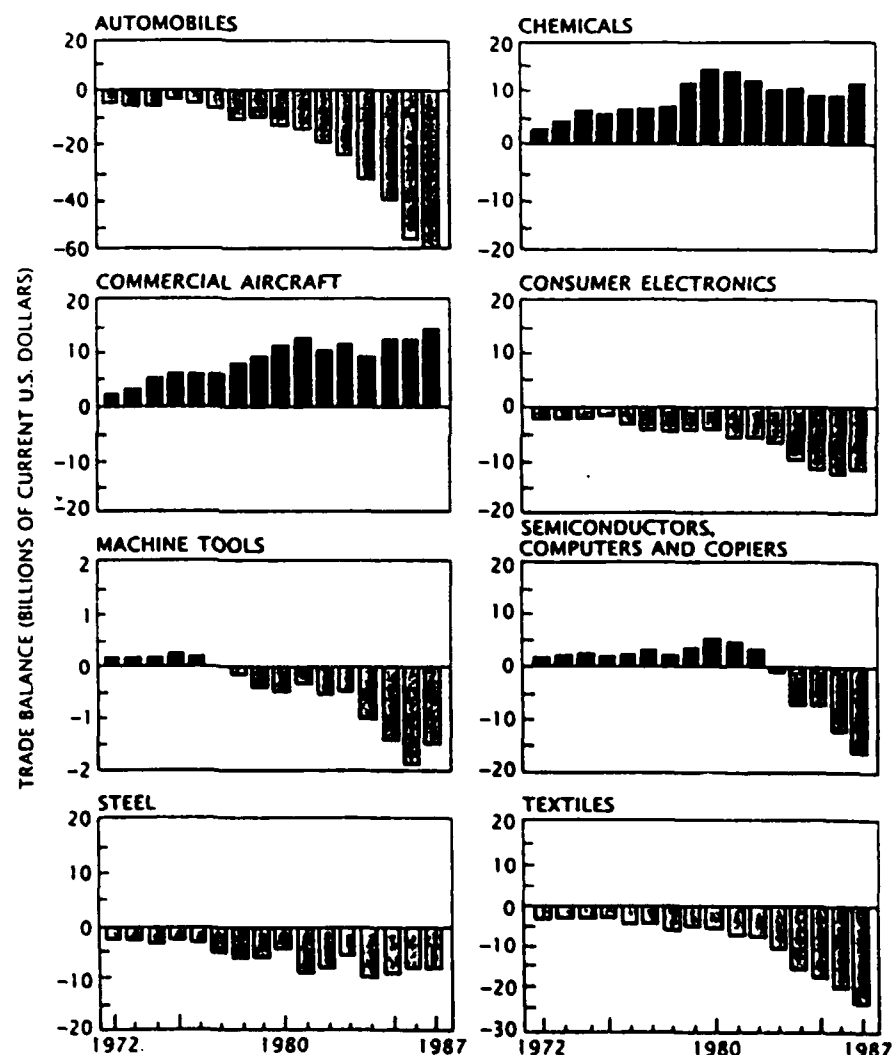
cede a potential market by not "sticking to their knitting"; instead, they diversify into activities that are more profitable in the short run.

The development of the videocassette recorder provides an exemplary case. Video-recording technology was first developed in the U.S., but the early machines were complex and expensive and suitable only for industrial and professional applications; many years of further development were needed to create low-cost, highly reliable products for the mass-consumer market. No American manufacturer was willing or able to spend the time and money, but several Japanese manufacturers were. The Japanese are now virtually unchallenged as makers

of the most important single product in the consumer-electronics market.

Why are U.S. firms less willing than their rivals to live through a period of heavy investment and meager returns in order to build expertise and secure a foothold in a new market? Is it that American managers are incapable of looking as far ahead as their foreign counterparts? Or are they forced by external circumstances to focus on the short term, even though they realize that it is not in their firm's best interest to do so? Or might it be that a short-term focus is actually in the best interest of the firm but not of the U.S. economy as a whole?

Some observers argue that the higher cost of capital in the U.S. compared



BALANCE OF TRADE (the total value of exports less the total value of imports) for the eight key manufacturing industries studied by the commission reflects the industries' general condition in the U.S. A positive balance means that more of an industry's products are sold overseas than are imported to the U.S. by foreign rivals; a negative balance implies the converse. An industry's trade balance is affected by the performance of its firms with respect to product cost and quality, service and the speed of response to new technological and market opportunities. Macroeconomic conditions—particularly currency-exchange rates—can also affect the balance.



NATURE OF U.S. SECURITIES MARKET has contributed to the short time horizons of American businesses. Managers of mutual and pension funds, which own a large and growing share of the capital of U.S. firms, tend to turn over their fund's stockholdings rapidly in an effort to maximize the current value of the investment portfolio. Such a strategy undervalues long-term development and investment policies of U.S. firms.

with its cost in Japan is the overriding reason for the different time horizons of firms in the two countries. Certainly the cost of capital is important, but we think that other factors are also important.

The nature of the institutions that influence the supply of capital may affect investment decisions at least as much as the cost of capital. A large and growing share of the capital of U.S. firms is owned by mutual funds and pension funds, which hold assets in the form of a market basket of securities. The actual equity holders, the clients of the funds, are far removed from managerial decision making. The fund managers also have no long-term loyalty to the corporations in which they invest and have no representation on their boards. (Indeed, legislation prohibits their participation in corporate planning.)

Although some fund managers do invest for the long term, most turn over their stockholdings rapidly in an effort to maximize the current value of their investment portfolio, since this is the main criterion against which their own performance is judged. Firms respond to this financial environment by maximizing their short-term profit in the belief that investment policies oriented toward the long term will be undervalued by the market and thus leave them vulnerable to a take-over.

At the same time senior executives are also motivated to maintain steady growth in earnings by their own profit-related bonus plans and stock op-

tions. A chief executive whose compensation is a strong function of his or her company's financial performance in the current year will naturally stress short-term results.

Explanations that cite the cost of capital and the sources of financing all tend to depict corporate managers as victims of circumstance, forced by external conditions into a short-term mind-set. Yet Robert H. Hayes and the late William J. Abernathy of the Harvard Business School have argued that executive ranks have come to be dominated by individuals who know too little about their firm's products, markets and production processes and who rely instead on quantifiable short-term financial criteria. These modern executives are more likely to engage in restructuring to bolster profits than to take risks on technological innovation.

As part of its work the commission sought to find not only patterns of weakness in U.S. industry but also patterns of change that are common to successful U.S. firms—firms that are doing well in the international arena. Indeed, we probably learned as much from what such "best practice" firms are doing right as from what many other U.S. firms are doing wrong.

In particular, we found that successful firms emphasize *simultaneous* improvements in quality, cost and speed of commercialization. Whereas other firms often trade off one dimension

of performance against another, only the best companies have made significant improvement in all three. To gauge progress, one common practice among the successful firms is to emphasize competitive benchmarking: comparing the performance of their products and work processes with those of the world leaders. At the Xerox Corporation, for example, quality improved by an order of magnitude over the past decade after the company instituted detailed comparison tests of Xerox copiers and competing Japanese models.

In addition, the best-practice firms we observed are developing closer ties to their customers. These ties enable companies to pick up more detailed signals from the market and thus to respond to different segments of demand. They also increase the likelihood of rapid response to shifts in the market. Even high-volume manufacturers have combined a continuing emphasis on economies of scale with a new flexibility, reflected in shorter production runs, faster product introductions and greater sensitivity to the diverse needs of customers.

Closer and more tightly coordinated relations with suppliers were also observed among the best-practice firms. In some cases, better coordination with suppliers has been achieved through the coercive power of market domination, in others by new forms of cooperation and negotiation. No matter how it comes about, coordination with external firms is crucial in cutting inventories (and thereby costs), in speeding up the flow of products and in reducing defects.

For example, Greenwood Mills, Inc. (a textile company specializing in the production of denim), brought down its inventory radically over two years, even as sales doubled. To achieve those results the company tightened up its own operations and at the same time negotiated new arrangements with suppliers, who now deliver on a just-in-time basis. In exchange, Greenwood Mills halved the number of its suppliers, leaving itself more vulnerable to price hikes but gaining the advantages of closer collaboration.

Most thriving firms in the U.S. have also realized that business strategies based on throwing new hardware at performance problems are unlikely to work. They have instead learned to integrate technology in their manufacturing and marketing strategies and to link them to organizational changes that promote teamwork, training and continuous learning. In the general-

ly depressed domestic apparel industry, firms such as the Model Garment Company and Levi Strauss & Company are succeeding by investing heavily in information technologies that allow them to fill orders very rapidly and reduce inventory levels.

In virtually all successful firms, the trend is toward greater functional integration and lesser organizational stratification, both of which promote quicker product development and increased responsiveness to changing markets. The Ford Motor Company was the first U.S. automobile company to experiment with cross-functional teams to speed the development and introduction of a new model. The product-development team for the Taurus model included representatives from planning, design, engineering, manufacturing and marketing. The specialists worked simultaneously rather than serially.

Flattening steep organizational hierarchies goes hand in hand with dismantling functional barriers. A flatter hierarchy generally enhances organizational flexibility. It also promotes closer relations with customers: a customer with a problem can speak directly with the group that has responsibility for the product instead of having to go through a sales department. In leaner, less hierarchical organizations the number of job categories at each level is reduced, and the responsibilities associated with particular jobs are broadened.

At the Chaparral Steel Company, for instance, there are almost 1,000 employees, and yet there are only four job levels. Production workers are responsible for identifying new technologies, training, meeting with customers and maintaining equipment. Foremen and crews install new equipment. Security guards are trained as emergency medical technicians, and they update computer records while on their shift.

An essential ingredient for greater worker responsibility and commitment is continual training. Large companies such as IBM have the resources to train their own workers. Having lower labor turnover, they also have more incentive to invest in training, because they are more likely to capture the benefits of that investment. Smaller companies do tend to draw more heavily on outside institutions for training, but there is often a major internal component as well.

The Kingsbury Machine Tool Corporation once built dedicated equipment

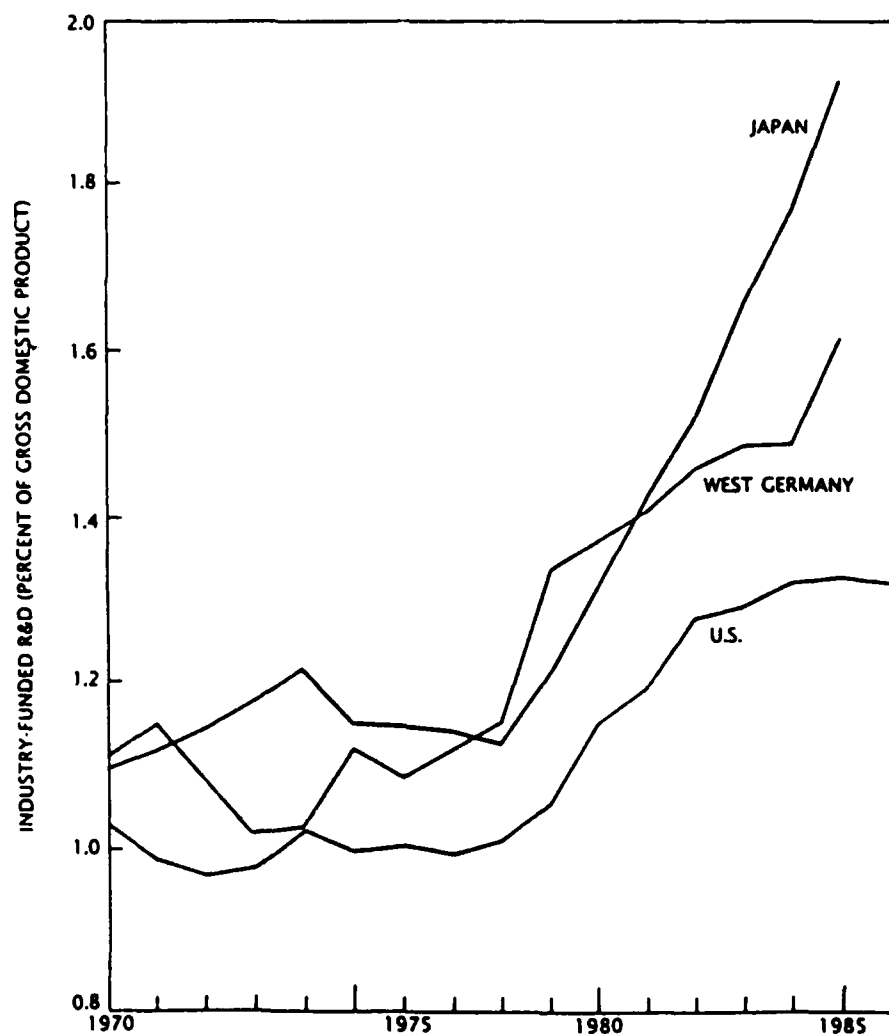
for vehicles; it has since successfully converted to building computer-controlled machines and production lines for flexible manufacturing. Under the old regime the primary demand on the work force was for mechanical skills, but the new product line requires workers with some knowledge of computers. To retrain the employees, the company provided everyone—from janitors to vice presidents—with computers to use at work or at home and offered classes to employees and their families.

Although an increasing number of American companies are recognizing what it takes to be the best in the world, many U.S. firms have not yet realized that they will have to make far-reaching changes in the way they do business. They will need to adopt new ways of thinking about human resources, new ways of organizing their systems of production and new

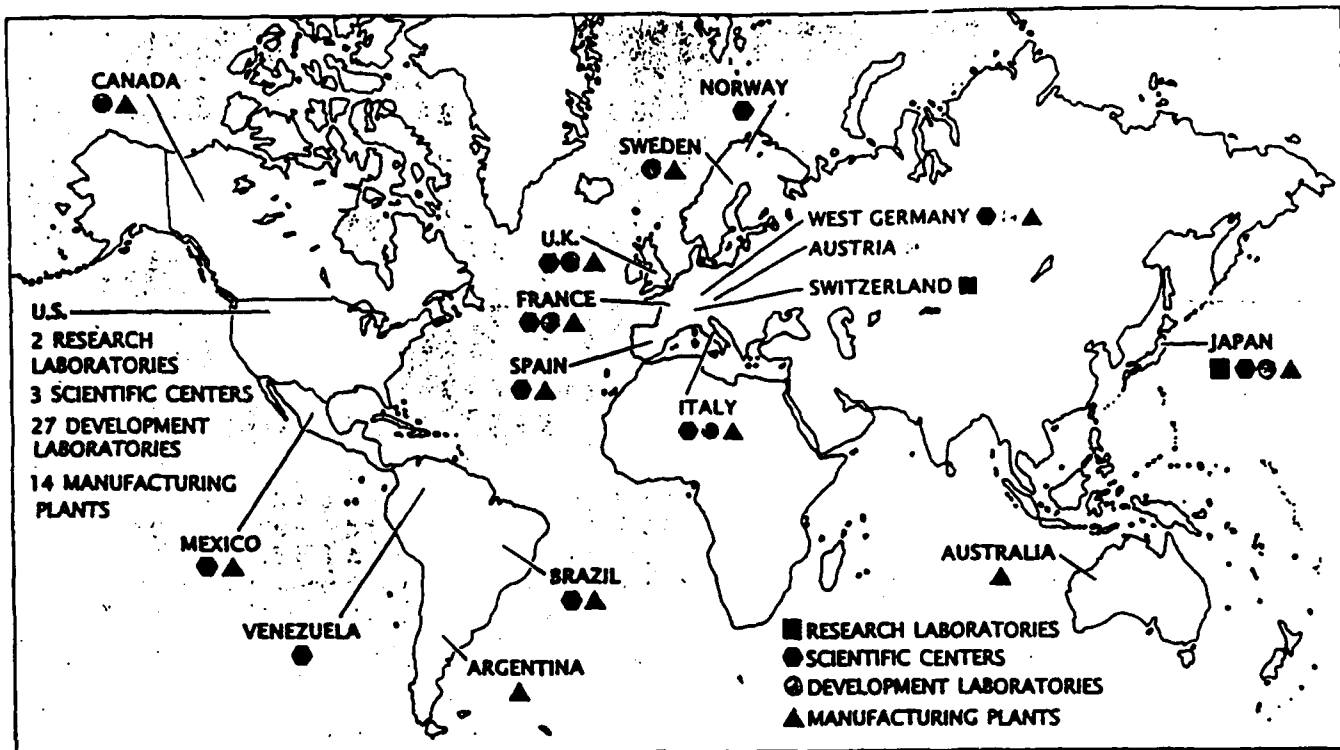
approaches to the management of technology. What distinguishes the best-practice firms from the others in their industries is that they see these innovations not as independent solutions but as a coherent package. Each change for the better reinforces the others, and the entire organization is affected by them.

Of course, today's best practices will surely not remain the best forever. The nature of industrial competition is changing rapidly, and new challenges will undoubtedly emerge. The commission identified three major and pervasive long-term trends that will have broad implications for the future productive performance of U.S. firms.

First, economic activity will continue to become more international. A company's ownership, location, work force, purchases and sales are all



INDUSTRY-FUNDED RESEARCH AND DEVELOPMENT has grown more slowly in the U.S. than in Japan and West Germany. Total spending on R&D as a percentage of gross domestic product, however, is about the same in the three countries, because the difference in industry-funded R&D is made up in the U.S. by federal funding of R&D.



INCREASING INTERNATIONALIZATION of the U.S. economy has led the International Business Machines Corporation to establish numerous research laboratories, scientific centers, development laboratories and manufacturing plants in foreign

countries. Such a geographic distribution helps the corporation remain abreast of technological advances throughout the world. IBM also maintains sales offices in more than 100 countries in order to keep in closer contact with its customers.

spreading beyond the boundaries of the nation in which it originated. A growing number of countries will acquire the capacity to produce and to export sophisticated goods and services. Many of these emerging economies have labor costs even lower than those of Taiwan and South Korea and far lower than those of the U.S., Japan and Europe.

Second, partly because of internationalization and partly because of rising incomes around the world, markets for consumer goods and intermediate goods are becoming more sophisticated. Markets are also becoming more segmented and specialized; not everyone is prepared to accept the same product designs and specifications.

Third, we expect the rapid pace of technological change to continue. Particularly rapid progress seems likely in information technology, materials science and engineering, and biotechnology. Information technology has already permeated nearly every facet of the production of goods and delivery of services, and we expect it to affect the business environment in a number of ways in the future.

The obvious implication of these three trends is that U.S. firms will

not be able to compete on the basis of cost alone. The future of U.S. industry lies in specialized, high-quality products; standard commodities will be made in the U.S. only if their production is extraordinarily capital-intensive and technologically advanced. At the same time, competition among U.S., Japanese and European firms in markets for high-value-added products will become increasingly fierce.

Indeed, the convergence of future consumer preferences, market forces and technological opportunities may lead in some industries to the introduction of "totally flexible" production systems. In such systems custom-tailoring of products to the needs and tastes of individual customers will be combined with the power, precision and economy of modern production technology.

In a market economy such as that of the U.S., individual firms have the primary responsibility to correct past problems and find ways to compete successfully in the future. Yet for the U.S. to achieve an economy marked by high productivity growth, all sectors—business, government, labor and educational institutions—will need to work together. Based on its

study of current weakness and best practices in American industry, as well as its forecast of long-term trends, the commission believes that five interconnected imperatives should form the core of any such national effort.

First, the U.S. needs to invest more heavily in its future. This means investment not only in tangible factories and machinery but also in research and, above all, in human capital. At the macroeconomic level, as noted earlier, bringing the budget closer into balance should take high priority. In order to encourage firms to develop the necessary outlook for long-term investments, American economic policy should also favor increasing productive investment over private consumption through an approach that combines a more expansionary monetary policy with a fiscal policy that taxes consumption more heavily than savings or investment. Such policies can increase the supply of capital to business. Tax and credit legislation making it harder and more expensive to raise large sums of money for takeovers and buy-outs is additionally needed. Government must also work with industry and academia to ensure not only that investment continues strongly in basic research but also that

it expands in the direction of productive manufacturing technologies.

Public resources should be allocated not only to improve the existing economic infrastructure (roads, airports, harbors and the like) but also to invest in new kinds of infrastructure. For example, we think that the time is right for American business and Government to begin developing a national information infrastructure, which would eventually become a network of communication highways as important for tomorrow's business as the current highway network is for today's flow of goods.

The most important investment in the long run is in the nation's schools. A better basic education will be crucial to the technological competence that will be required to raise the productivity of U.S. industry. Without major improvements in primary and secondary schooling, no amount of macro-economic fine-tuning or technological innovation will yield a rising standard of living.

The second major imperative, closely related to the first, is to develop a new "economic citizenship" in the workplace. The effective use of modern technology will require people to develop their capabilities for planning, judgment, collaboration and the analysis of complex systems. For that reason learning—particularly through on-the-job training programs—will acquire new importance.

Greater employee involvement and responsibility will be needed to absorb the new production technologies. Companies will no longer be able to treat employees like cogs in a big and impersonal machine. If people are asked to give maximum effort and to accept uncertainty and rapid change, they must be full participants in the enterprise rather than expendable commodities. Just as important as job security is a financial stake in the long-term performance of the firm. We see in this combination of technological and organizational change an unprecedented opportunity to make jobs more satisfying and rewarding for workers at all levels of a firm.

Third, the U.S. needs to make a major commitment to mastering the new fundamentals of manufacturing. Manufacturing, as we use the term here, encompasses a great deal more than what happens on a production line. It includes designing and developing products as well as planning, marketing, selling and servicing them. Global competition, changing markets and modern technologies are transform-

ing virtually every phase of the production system.

Managers who are detached from the details of production will lose the competitive battle to managers who know their business intimately. Manufacturability, reliability and low cost should be built into products at the earliest possible stages of design. Innovation must be applied to process development as intensively and creatively as it is now applied to product development. Corporate management and financial institutions must work together to develop indicators that better reflect how well companies are actually doing in developing, producing and marketing their products than do short-term financial measures such as quarterly earnings. New measures might include indicators of quality, productivity, product-development time and time to market.

Fourth, Americans should strive to combine cooperation and individualism. The nation's culture has traditionally emphasized individualism, often at the expense of cooperation. Yet in the best U.S. companies (as in other societies), group solidarity, a feeling of community and a recognition of interdependence have led to important economic advantages.

To this end, steep organizational hierarchies, with their rigidity and compartmentalization, should be replaced with substantially flatter organizational structures that provide incentives for communication and cooperation among different corporate departments. Companies should put less emphasis on legalistic and often adversarial contractual agreements; they should promote business relations based on mutual trust, common goals and the prospect of continuing transactions over the long run. Management must also accept workers and their representatives as legitimate partners in the innovation process. Both individual and group efforts need recognition and reward.

Americans should think of cooperation among economic entities as a way of overcoming the defects of the market, which often undersupplies collective factors essential to economic success. Cooperative efforts can take the form of research consortiums, joint business ventures, partnerships with Government and standard-setting committees. (To be sure, such arrangements might lead producers to combine forces in order to exploit the consumer. Now and in the future, competition from imports will no doubt provide some protection

from domestic monopolies. Still, a little vigilance would help too.)

Fifth, to compete successfully in a world that is becoming more international and more competitive, Americans must expand their outlook beyond their own boundaries. They must gain knowledge of other languages, cultures, market customs, tastes, legal systems and regulations; they will need to develop a new set of international sensitivities.

Cost considerations will increasingly dictate whether materials and components are best procured at home or abroad. It follows that not only a company's marketing division but also its purchasing agents and production managers will have to be knowledgeable about global conditions. Shopping internationally should go beyond the buying of raw materials and off-the-shelf products to the adoption of effective practices and technologies—wherever they happen to be found.

Americans need to understand that the world they live in has changed. The effortless economic superiority that the U.S. enjoyed in the aftermath of World War II has gone. Strong economic cultures now exist across both the Atlantic and Pacific oceans. The U.S. has much to learn from the rest of the world. Indeed, the rest of the world will force changes in some of the most cherished American operating procedures and assumptions, if the U.S. is to continue to have a standard of living second to none. What Americans must do is determined decreasingly by what they wish to do and increasingly by the best practices of others.

Implementing these five imperatives will not be easy. In many cases, fundamental changes in attitude will be necessary. Just accepting the need for a sense of common purpose—a shared national goal—may require the biggest attitudinal change of all. The commission believes that if industry, government and the educational system in this country unite in steadfast pursuit of these basic imperatives the next generation of Americans will live in a nation moving into the 21st century with the same dynamism and strength that made it a world leader a generation ago.

FURTHER READING

MADE IN AMERICA: REGAINING THE PRODUCTIVE EDGE. Michael L. Dertouzos, Richard K. Lester, Robert M. Solow and the MIT Commission on Industrial Productivity. The MIT Press, 1989.

SECTION II: MANAGEMENT FOR IMPROVEMENT OF ORGANIZATIONAL QUALITY

Metz, E. J. (Summer 1984). Managing change: Implementing productivity and quality improvements. National Productivity Review, 3, 303-314.

Baker, E. M. (June 15, 1987). Achieving competitive viability in the new economic age: Quality excellence in administrative, service, and support systems. Available from E. M. Baker, Director, Quality Planning and Statistical Methods, Ford Motor Company, Detroit, MI 48121.

Changes in an organization's competitive environment often make it necessary for the organization to respond with changes in its internal structure and strategic direction. Successful management of such change is the responsibility of the top leadership of the organization.

Metz describes the types of organizational change efforts that have been most successful in helping organizations to create and sustain a competitive advantage in quality, cost, and productivity. Baker describes how organizations can manage a process of stable, effective, and lasting change while avoiding much of the confusion and chaos that often accompany organizational change efforts.

Metz, E. J. (Summer 1984). Managing change: Implementing productivity and quality improvements. National Productivity Review, 3, 303-314.

Metz describes three approaches used by organizations in implementing programs for improvement of quality and productivity. He concludes that adoption of a strategic change management process is key to long-term improvements in quality and productivity. He compares the ineffectiveness of companies whose goals for productivity and quality are short-term with the slower but more effective approaches of companies that strive to attain these improvements through organizational change. The latter organizations take the view that long-term improvement will result only from the design and implementation of organizational systems within which improvements are gradual, continuous, and planned.

Managing Change: Implementing Productivity and Quality Improvements

The current range of approaches for implementing improvement efforts is defined, and the various alternatives are evaluated.

Edmund J. Metz

In recent years, organizations have implemented productivity and quality improvement efforts to meet international competitive challenges. As an organization consultant, I have observed a predominant implementation pattern for such efforts. That pattern can best be described as too short-term, programmatic, and segmented to achieve enduring productivity and quality gains. To obtain lasting benefits, a strategically integrated, organizationwide approach is required.

My purpose in this article is to share some general observations of how organizations are approaching productivity and quality improvements, describe some of the limitations of the predominant implementation pattern, identify what needs to be done better, and develop a scenario of some desirable future state characteristics by which productivity and quality improvements are strategically linked and enduring.

Implementation patterns

A large midwestern electronics company has had a formal "productivity" program under way for the last five years. A number of different programs were approved by a management productivity council, yet the results have fallen somewhat below management's expectations. During those five years, over a dozen different and independent departmental efforts to improve productivity were started, while the company went through three presidents and continued to experience headcount reductions due to declining market share. Business pressures encouraged a strong short-term focus on results and the technical orientation of management resulted in an abnormally high infatuation with measurements and control.

When I first became acquainted with this orga-

Far too many improvement efforts will fail to tap the full extent of potential opportunity gains.

nization over two years ago, I thought the situation was somewhat unusual. However, a number of organizational situations I have since seen or heard about lead me to conclude that many organizations have had similar experiences in implementing productivity and quality improvements.

The theme for this article initially grew out of two questions I had been asking about improvement of productivity and quality: "What are companies doing?" and "How are they doing it?" I asked these questions of representatives of thirty-eight Fortune 500 companies that are members of the American Productivity Center or the American Productivity Management Association. I detected three general implementation approaches, summarized in Table I. Although the given commonality is the goals of productivity and quality improvement, the three general implementation approaches raise the important question of which approach would generate the productivity and quality gains most likely to endure over the long term.

Six key implementation characteristics

The majority of current efforts to improve productivity and quality will produce some results if only because of the Hawthorne effect. But while most will certainly produce some gains in the short term, far too many efforts will fail to tap the full extent of potential opportunity gains.

My experiences in organizational consulting convince me that the potential for enduring, long-term success increases as one moves from left to right across Table I, which summarizes the six most significant implementation characteristics for each of the three major implementation approaches. Unfortunately, it is the Type I approach on the left—programmatic and oriented to the short term—that is the most commonly used. Only a very small number of organizations are using the more strategic approach of Type III, on the right. However, I believe that Table I depicts what will be an evolution of organizational methodology from Type I to Type III. That is, I feel that all firms using Type I and Type II methodology will eventually, through trial and error, move toward adopting the characteristics of a Type III approach.

Below, the approaches are compared by examining their implementation characteristics.

Official banner

I have categorized the approaches companies are taking to productivity and quality improvement under three different banners. The most common banner is that which designates an improvement approach as a productivity or quality program (Type I). Another popular approach seeks to generate improvements under the broad banner of quality of work life (Type II). The third implementation approach (Type III), going under various banners, views productivity and quality improvements as consequences or products of a consciously designed organizational system or culture. Most energy is spent in systems redesign and managing strategic change rather than in implementing programs at lower organizational levels.

Although the selection of banners makes it appear that the three approaches are entirely distinct, in fact they merge into an evolutionary continuum, with some companies having characteristics that fit under more than one approach.

The simplification of reality by the use of a banner has both positive and negative consequences. It helps to give an approach an identity and thereby serves as a rallying point for people's efforts. However, banners can also limit or obscure what needs to be done.

The difficulty with productivity program banners is that they create the impression that what they are describing is just another isolated program (which is now starting and will therefore also end once the productivity problem is "fixed"), and does not help people understand that some fundamental changes need to be made in work systems. Management's approach may be too programmatic to begin with, but the choice of banner can reinforce the problem.

Quality-of-work-life (QWL) banners are better in the sense that they serve as an umbrella for a broader and more all-inclusive effort, potentially encompassing productivity, quality, QWL, and sociotechnical systems change.

A possible problem with some of the banners

Table 1
Organization Approaches to Implementing Productivity and Quality Improvements

Implementation Characteristics	Productivity/Quality Program (Type I)	QWL Program (Type II)	Organizational Redesign (Type II)
1. Official banner	Productivity or quality identified as main goal	QWL is main label, or productivity disguised as QWL	Varied individual labels—a holistic organizational view that may include OD and culture change
2. Measurements	Measurements emphasized	Measurements used	Measurements used
3. Methodology	Programmatic, with formal systems left in place and generally unchanged	Some programmatic features but also varying degrees of socio.technical change	Systems redesign based on clear beliefs, philosophies, values, and the development of teamwork at all levels
4. Responsibilities and leadership	Delegated by CEO to others to implement; about 1/4 of the Fortune 1000 have established a formal productivity person/dept.	Delegated responsibility, but with more active involvement of CEO and management	CEO actively involved in shaping new values and culture; high management participation at all levels
5. Degree of employee involvement	Some opportunities, but tending to be limited and voluntary, e.g.: —work simplification —quality circles —value engineering —communication programs	Broader range of involvement activities: —quality circles —participation teams —peer reviews —team building —gainsharing	Involvement by all people at all levels actively sought, generally not voluntary: —culture change —employee involvement —team building —statistical quality control
6. Strategic focus	Limited; improvement efforts usually not integrated with strategic planning process	Improvement efforts may be somewhat linked and integrated with strategic planning process	Improvement efforts clearly linked and integrated with strategic process

In the multiprogram approach, too little thought is given to designing horizontal and vertical linkages among the programs.

used for organization redesign (Type III)—e.g., Sociotechnical Systems, Organization Effectiveness, Open Systems Planning—is that because they are insufficiently descriptive, people may have difficulty understanding what the effort is really all about.

Measurements

As a general proposition, Type I companies tend not only to place the most emphasis on measurements but also to create and add new measurements to those already in existence. Additionally, a number of these companies have made frustrating attempts to develop a simple productivity measure that could readily convert all the organization's efforts to a final bottom-line number encompassing and accurately summarizing total gains and progress. Type II and Type III companies also use measurements, but they appear to make a more balanced assessment of the importance of the measurements in relation to other, less quantifiable factors of success (i.e., trust, satisfaction, teamwork, goal orientation, etc.). In such companies, success is measured in qualitative as well as quantitative ways.

Although measurements are important, they have some limitations. Measurements can become ends in themselves. Another common pitfall is the tendency to overmeasure. The infatuation with academic analytical techniques, the advent and proliferation of computer technology, and management's traditional desire to control has led many companies to overemphasize measurements. Some companies have gotten so bogged down in analysis and measurements that they have made little progress with their productivity and quality efforts. Too much stress on measurements has also been a cause of worker mistrust and alienation because in the past management has too often used measurements to control and punish people. In addition to these problems, Type I companies further limit their success by overemphasizing harder measures to the exclusion of more qualitative measurement factors. They would do well to examine the range of measurements, the question of ownership of measures, and the related informal reward systems used in some of the so-called excellent companies.

Methodology

The word "program" is very much a part of the everyday language in the methodology of Type I implementations. Programs are associated with starting and terminating dates. Managers chosen as program implementers are usually expected to outline or develop a workable program, and then bring it to a successful conclusion. Due to the discrete nature of programs, there are sometimes a number of independent programs existing separately and without coordination. One department might be rearranging machinery while another is launching quality circles; one manager might be cracking down on absenteeism and abuse of lunch time while another is introducing an incentive program. The rationale given for this multiprogram approach is typically that programs need to be "customized" to fit specific needs. Little thought is given to organizational readiness, effective implementation sequencing, and designing horizontal and vertical linkages among programs.



Type I organizations tend to have a limited understanding of what broad-based change requires.

The programmatic approach of Type I companies is often used because it is comfortable for managers who prefer to perpetuate traditional forms of relationships and work structures. But it is not surprising that when this programmatic response tendency is indulged, one hears about the frustration these managers feel regarding the insufficient progress of their efforts. While the majority of managers with productivity and quality improvement responsibility do view themselves as "change" managers, they most often end up being program managers who fail to use a strategic change management process. Managers in Type I companies say that they want to instill productivity and quality improvement in the organization as "values," and there is some appreciation of the need to integrate improvement into the management system. However, the programmatic efforts are limiting because values are cultural variables, which those efforts ignore. The programmatic view of the management system is too limited, including only the rational or visible systems of planning, directing, operating, and controlling. It fails to direct energy to changing the nonrational and invisible systems (e.g., climate, culture, values, beliefs, norms, management philosophies and practices, etc.).

Although I have found no definitive study of current implementation methodology, the informal information strongly indicates that in only a small number of cases does one find the application of organization systems theory and strategic change management to improvement effort. The few organizations leading the way are Type III companies which have learned that organizational effectiveness rests upon the degree to which an organization systematically realigns its subsystems (social, technical, and administrative) to adequately meet strategic shifts. They are moving toward a more collaborative framework that emphasizes greater spontaneity in management action through teams, growing attention to organizational cultures, and a broader, more inclusive strategic planning process.

Type I companies do go through a subsystem realignment process, but it is an unconscious and haphazard process brought about through a trial-and-error, reactive approach of implementing productivity and quality programs unconnected to any long-term strategic direction; on the other hand, Type III companies are engaged in managing a defined transition in an explicit, deliberate, and proactive manner.

Responsibilities and leadership

The degree of active top leadership support and involvement increases from Type I to Type III companies. A fairly typical scenario in Type I companies is the declaration of the need for productivity and quality improvements by edict of the CEO or president, with the task of achieving improvement frequently delegated to a staff person or, in some instances, to a specially created productivity "czar." In Type III companies, too, the CEO may unilaterally declare the need for some change or improvement, but he or she also shows a genuine long-term interest and a relatively high sensitivity to the impact of top leadership style on the culture, and takes an active role to lessen resistance to the instilling of new values into the culture. This personal and active involvement results in higher levels of management acceptance and ownership for success.

The view that a company takes of leadership role and responsibility can enhance or limit success. In Type I companies, top leadership has a limited view of its role and responsibility in the total improvement process. It typically pronounces its organizational support and then appoints a line manager with only an operations or technical background to direct the process. These managers then approach their task asking the question, "What programs should I implement?" when they should be asking, "What changes do I need to manage?" After all, top management hasn't created and supported such new managerial roles because they wanted "programs" implemented. While on the surface it may appear that the mandate is to start a productivity or quality program, the real desire is less program specific: it is to see a change in the existing productivity and quality levels. The responsibility of these managers should be that of implementing and managing change, not programs. Top management frequently fails to see the need for their intimate, active involvement in this responsibility, which is one that cannot be so completely delegated to anyone else as described above.

But the problem in Type I organizations is not just the failure of top management to see that it must be actively involved in broad-based change. In addition, it tends to have a limited understanding of what broad-based change requires. It is prone to perceive change only in terms of what workers must do—adapting to the organization's needs, working harder, and perhaps

showing more support for the goals set by management. Managements using the Type III approach recognize the mutuality of responsibilities in the management-worker relationship, and therefore realize that the organization itself may have to change fundamentally in order to achieve the desired productivity and quality gains. In both cases, management sees the need for broad-based change, but the view of what needs to change typically differs.

A major obstacle to strategic change within Type I and Type II companies is the attitude of the middle management group and the prevailing system of political dynamics. Most middle managers are fearful of beginning a productivity improvement effort on their own because of the possible imbalance it may create in the existing political system. Although the main role of the productivity manager is supposed to be that of an "integrator," helping top and middle management to develop a plan for integrating productivity improvement into the corporate strategy, culture, and systems, all too frequently the role becomes that of a "program implementer" who ends up spending considerable energy just trying to overcome middle management resistance while attempting to position program ownership in the laps of line managers. Again, top management involvement is needed if a programmatic focus is to be avoided.

Degree of employee involvement

A universal feature of productivity and quality improvement efforts is the use of employee involvement, for the general belief is that productivity cannot be raised nor quality improved without involving employees.

The amount of organizationwide employee involvement increases from Type I to Type III companies. Limitations on involvement are inherent in Type I organizations because they implement programs while leaving work and social systems, values and culture, untouched. In addition, while efforts are made to involve employees, this involvement process is often not extended into management ranks. In Type III companies, opportunities for team involvement appear to be greater at all levels of the organization, teamwork is a more valued norm, participative management is consciously

encouraged, and authority and responsibility points are appropriately positioned for team decisions.

Although the two absolute essentials for productivity and quality improvement are change and employee involvement, Type I companies limit their own success because their philosophy of employee involvement limits the process. For example, in quality-circle or employee participation group programs, benefits are lost because involvement is voluntary. People who could contribute, but who don't volunteer for one reason or another, have little or no input into the improvements. Managers frequently believe that such programs are fine for rank-and-file workers yet have little applicability in management ranks.

Productivity and quality cannot be raised substantially without involving everyone in the organization in as many ways as possible. All key managers who control resources should be involved in guiding the transition to a more productive organization. Managers and supervisors need to be actively involved in the design of implementation tactics and cross-coordinated departmental activities. All employees should not only be actively involved in solving problems but should also accept decision-making responsibility and a level of accountability previously shouldered only by supervisors. The degree of involvement relates directly to the level of long-term success, measured strategically.

Strategic focus

Although some degree of strategic planning is generally used by companies across the chart, two key dimensions of the strategic process change as one moves from Type I to Type III implementations. The first is the *time* focus of the process and the second is the *inclusiveness* of the process. Type I companies appear to be using a strategic process developed in the 1970s, whose coverage tends to be restricted primarily to technical areas and that has a three- to five-year time span. Type III companies tend to use a broader-based and more contemporary process that to a much greater degree includes and integrates horizontal functions (i.e., R&D, marketing, operations, finance, human resources, etc.) within a context of a total organizational framework (i.e., a systems approach including social, operational, and administrative systems), and

The failure to adopt a strategic change management process will limit the success of any improvement effort.

has a time frame of five years and beyond. In Type III companies, strategic human-resource management is a very important binder element serving to link the various organizational pieces.

Program versus strategic change

The failure to adopt a strategic change management process will limit the success of any improvement effort. The programmatic energy expended by Type I companies is aimed at raising certain productivity and quality measures in the short term, not at designing a system within which such improvements will flow as a planned and long-term consequence of the system. So long as productivity and quality improvements are just another company program, lacking a long-term strategy, without a defined view of a specific organizational future, and not incorporated into the business strategy, there will be inherent limits to both its potential for short-term gains and its long-term viability.

What needs to be done better?

If long-term durability of productivity and quality gains are desirable, then what changes need to be made in how such efforts are implemented? Although there is no one universally accepted implementation approach, two fairly typical models are summarized in Table 2. While these models are certainly sound and valid, there are nevertheless at least two significant problems associated with them. The first of the two discussed below stems from management's failure to implement the models properly, while the second is inherent in the models themselves.

1. *Diagnostic neglect.* Although both models as well as others I have seen strongly encourage a diagnostic assessment, too many companies are ignoring this fundamental advice. In a speech delivered at the Annual Industrial Engineering Conference and Exposition in Louisville, Kentucky on May 25, 1983, Bill Ginnodo, associate director of the American Productiv-

Table 2
Productivity and Quality Improvement Implementation Models

Operations Model*	Organization Development Model**
1. Assess. Find out where you stand and what needs to be done.	1. Awareness of needs. Brings productivity improvement problems to the attention of top management; is based on actual conditions in the operating facility.
2. Organize. Decide what's going to be done, by whom, by what time, etc. This includes deciding what tools and techniques are most appropriate.	2. Entry of the specialist. Builds an agreement between management and the human-resources development specialist to focus on particular problems.
3. Raise awareness. Consider also doing this before and after assessment.	3. Diagnosis. Entails collecting and analyzing data.
4. Implement change.	4. Problems identified. Analyzed data is presented to management.
5. Evaluation and reinforcement. Do this to determine what has changed, whether further action is needed, and who should be recognized for their accomplishments.	5. Action plans. Involves taking the leap from problem to possible solutions. The specialist provides information, ideas, and resources.
	6. Implementation and improvements. Requires problem-solving sessions and the support and commitment of management.

*Based on a speech delivered by Bill Ginnodo at the Annual Industrial Engineering Conference and Exposition in Louisville, Kentucky on May 25, 1983.

**Based on Eric L. Herzog, "Improving Productivity Via Organization Development," *Training and Development Journal* 34(4):36-39, April 1980.

The vast majority of diagnostic instruments tend to be content focused and thus unsuitable for broad-based assessments.

ity Management Association, commented on this problem:

... the human resources director of one of the country's biggest users of quality circles recently told me: "employees and managers learn a lot about participation from circles but I'm convinced we shouldn't have gone that way. I wish we had spent more time up front, studying our needs and developing a fuller program. I'm sure we would have done things differently." ... During a break in one of the APMA's national meetings, I approached the group that had surrounded the last speaker—a productivity manager from a pharmaceutical firm—and heard someone ask him, "If you could begin your program all over again, what would you do differently?" Without hesitating, the speaker said, "I'd do a more complete assessment. We missed the mark in quite a few areas."

Even if a productivity manager decided to do a diagnosis, another difficulty is finding a diagnostic instrument that has broad-based systems scope and that can be readily interpreted so as to be of practical use to operating people. While there are a number of instruments available, the vast majority tend to be somewhat content focused and thus unsuitable for broad-based assessments. However, for assessing the social and managerial system, the Survey-Guided Development Process developed by the Institute for Social Research at the University of Michigan is one of the best surveys available. In order to assess the productivity of the operating system itself, the Industrial Productivity Institute has developed what is called the Team Productivity System survey. In combination, these two assessments are a powerful assessment package.¹

2. Lack of orientation to a strategic change management process. For there to be productivity and quality improvement, carefully managed strategic change is required. Unfortunately, the models summarized in Table 2 have a programmatic connotation. For example, regarding stage 1 in the OD model, Eric Herzog states:

... the organization and human resource specialist can assist top management in developing

any number of programs to heighten awareness in the existing manufacturing facility to the need for improved productivity. These types of programs may include: (1) Absenteeism ... (2) Cost-reduction ... (3) Improved identification with product and company ... (4) Improved training ... etc.²

Note that the organization will have already established the norm of applying programmatic solutions even before the problems have been diagnosed. The models do mention "change," yet fail to spell out in detail the techniques of even a simple change management process. While the models' basic steps help managers get started, improvement efforts frequently lose steam and focus because of this lack of greater specificity in the models. Some companies following a Type III implementation have recognized this weakness and have spent more time conceptualizing the stages and phases of change before taking action, thus keeping their improvement efforts clearly focused and directed. The result was described by Bill Ginnodo in the aforementioned May 1983 speech at the Annual Industrial Engineering Conference and Exposition: "We've been impressed by the fact that some of our APMA member companies have 'planned' their way through these stages, rather than work through them by trial-and-error."

Even where managers recognize the need for such change, these models limit their view of what needs to be changed. For example, change programs may be too narrowly focused on altering only employee attitudes or in just solving certain types of technical operating problems. Management usually fails to see or appreciate the extent and depth of changes that need to be made. One reason for this is that in school, managers have been taught "linear" management models (concepts of planning, leading, organizing, controlling) such as those under discussion here; i.e., they are taught to manage organizations as rational entities. Therefore, they encounter problems when they try to instill values of productivity and quality into the visible and linear management system. Values are not a part of such a system but are rather part of the invisible and nonlinear system called culture. Culture cannot be changed through the programmatic process suggested by the models currently in use.

If the projections of continued high rates of

Key managers should be involved in building a vision of what the company wants and needs to be.

technology change hold true through the 1990s, the degree of environmental turbulence that they foretell will require a more complete strategic planning process than was developed in the 1970s. A comprehensive, long-term horizontally and vertically linked strategy needs to be developed. A company's productivity and quality strategy will have to cover the entire organization with all its systems and procedures, and will need to be incorporated into the overall business strategy. Long-term improvements will not be accomplished without permanent changes in the level of employee involvement; without changes in the points of authority, responsibility, and decision making; without changes in management philosophies, styles, and relationships; and without changes in climate and culture. But a broad strategic approach is not even mentioned in either of the models, although it is the only real hope for achieving lasting gains.

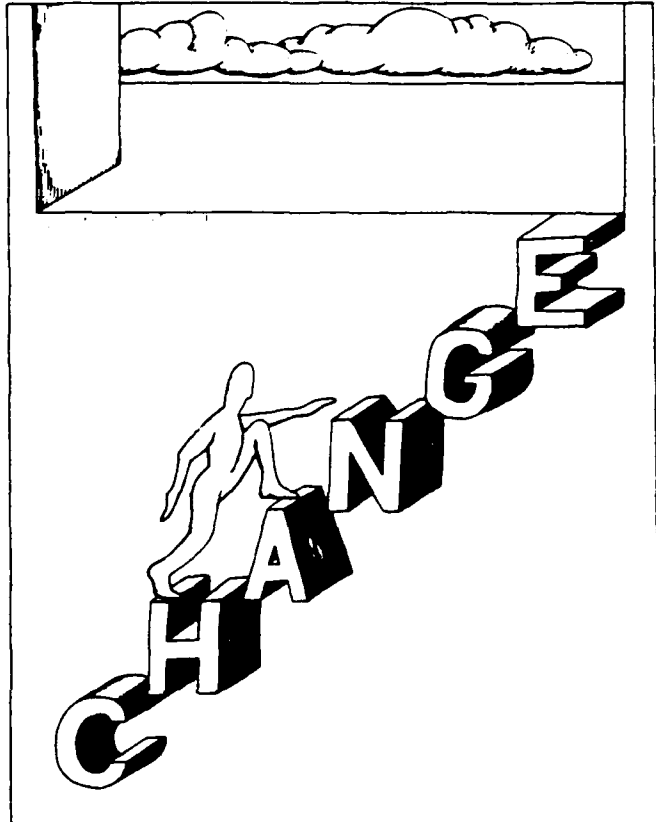
A direction for change

The idea of developing a strategic approach to organization productivity and quality improvements ought to raise questions and concerns for the managers in Type I companies—and there are many such managers, because the Type I implementation methodology represents the predominant approach being used by the Fortune 1000. Should all of the productivity and quality efforts already started in the context of this methodology be scrapped? How does a productivity manager approach changing the direction of the existing effort?

Existing efforts need not be scrapped. But the focus of energy, attention, and work needs to be consciously and systematically shifted.

It is essential to move from a programmatic to a strategic change approach. The first step in doing so is identifying the critical group of people in the organization that controls resources. The support and involvement of that group is essential if any substantial and strategic change is to occur.

With that support, the organization must proceed to redesign its culture. Cultures are very difficult to change, given the systemic resistances (political,



social, structural, etc.) that exist. Rather than approach a culture change directly, the productivity manager should get key managers actively involved in building a vision of what the company wants and needs to be (i.e., defining a future state where the desired productivity and quality goals are being achieved) before confronting the reality of what the company is actually like today. This approach will serve to reduce resistance to change, build participative management ownership, develop support for moving toward a defined future, gain visibility and agreement for the need to change the organization fundamentally and substantially, and help managers begin to understand the strategic impact of cause and effect relationships in the organization's systems.

Four key steps to planning and organizing a redesign are:

1. *Definition of a philosophy.* Every organization has a climate and culture and operates according to some set of philosophical principles, whether stated or

Strategic human-resource planning should be closely linked to business planning to minimize work-force fluctuations.

not. As part of defining the desired organizational future, involve managers in developing a statement of what the company's philosophy should be.

2. *Definition of goals and values.* Organization goals need to be clearly stated and communicated to everyone. Peter Vaill calls this "purposing," which he defines as "that continuous stream of actions by an organization's formal leadership which have the effect of inducing clarity, consensus, and commitment regarding the organization's basic purpose."³ In addition to goals, managers need to define and explicitly state the values the organization should foster in the desired future state. In their *In Search of Excellence*, Thomas J. Peters and Robert H. Waterman state the following regarding the importance of values:

... let us suppose that you were asked for one all-purpose bit of advice for management, one truth that we were able to distill from the excellent companies' research. We might be tempted to reply, figure out your value system, decide what your company stands for ... put yourself out ten or twenty years in the future.

3. *Organization of a transition steering committee.* Many of the people appointed to coordinate or manage a productivity or quality improvement effort end up being the focal point of the effort, with management expecting them to develop (usually on their own) a workable program and to successfully facilitate the implementation of that program. The formation of a management steering committee as a planning and decision-making body not only builds management ownership for success but can also serve the function of the parallel structure needed to manage the transition between the present and the future state. Where a steering committee already exists, its work should be expanded to include future state definition in addition to current programmatic considerations.

4. *Development of the strategic change plan.* The plan to improve productivity and quality should be developed by the steering committee, with the participation and involvement of other managers. This plan should encompass all the major systems: people, structure, technology, administrative policies and pro-

cedures, and culture. When completed, this plan becomes a focused business strategy explicitly aligned with other business strategies, a systems-based approach linking specifically targeted efforts into a consistent and coordinated whole. The key to managing the transition to a highly productivity- and quality-conscious organization is the alignment of all of the organization's key components—its mission and strategy, its structure, and its human resources—within the operating, administrative, social, political, and cultural systems; and to align each of these systems with the others. When done properly, the organization will have managed a strategic redesign to a cultural system where high productivity and quality are a way of life.

Defining the future state

I will conclude by presenting some of the characteristics of organizations in their desired future state: i.e., after they have adopted an integrated strategic approach to productivity and quality improvement.

The definition of the desired future state of the organization should be an extended, wide-angle "photograph" of what the organization would look like in its new state. This definition should explicitly include such areas as:

- Philosophy, mission, and values;
- Expected organization structure;
- Reward system;
- Personnel policies;
- Authority and task/responsibility distributions;
- Managerial styles;
- Performance review systems; and
- Performance outcomes.

If we were to do some crystal ball gazing to identify a few of the more significant future state characteristics expected in firms that have enduring and significant productivity and quality gains, what might we find? Looking at some of the firms that have already designed such organizations, we find such characteristics as the following:

The organization should make a specific commitment to provide job security at all levels.

1. An ongoing, data-based diagnostic process serves as a feedback mechanism providing periodic systemic "snapshots" of the evolving organization. This diagnostic process is complementary to existing traditional measurements.

2. Strategic human-resource planning is closely linked to business planning. This helps to level work loading and minimize work-force fluctuations due to layoffs. Stable work environments are needed to foster the values of involvement and teamwork.

3. Management participation includes everyone, in some way, from the CEO down through the supervisory ranks. Should a key decision maker leave, the process will continue because the goals are commonly known, the ownership is shared, and the values are deeply ingrained into the culture.

4. Where a union exists, the fundamental philosophy of management toward it is one that values trust, open sharing of information, mutual support and cooperation, and joint participation in all decisions.

5. Managers have the skills to manage a changing and evolving organization, not static entities. Decisions are more decentralized and happen faster. Managing high productivity and high quality systems is an ongoing process, not time limited by a programmatic schedule with a beginning and end.

6. Organization goals are formally stated, written, and known to everyone. The goals are specific, clear, and apply to all, with defined rewards for both management and employees for achievement.

7. The values of productivity and quality cover more than just product or service. These values are shared by all, regardless of job, level, or function. They are diffused and pervasive, affecting daily work habits and working relationships.

8. Training (job, technical, and management skills) is a vital part of the culture. There is ample opportunity for and encouragement of growth, development, and renewal.

9. Because human resources are recognized as the most valuable resource any organization has, the organization has made a specific commitment to provide job security to people at all levels, assuring that no employee will lose his or her job because of improvements in productivity and quality.

10. Performance goals are set mutually by management and workers, with points of responsibility and accountability pushed down to the lowest possible level.

11. Management will operate more clearly in accordance with explicit values and a socially responsive ethical framework. Its style will be characterized by participation, entrepreneurship, human-resources primacy, and proactive management of the organizational response to the increasingly uncertain technical developments of the coming decade.

Conclusion

Managing change is always time-consuming and never easy, and it requires long-term management dedication. But in order to achieve the type of long-term high levels of productivity and quality needed if U.S. firms are to be internationally competitive, managers must put aside outmoded organizational structures and practices. To assure competitive futures for their organizations, they must also go beyond timid experimentation with programs in a trial-and-error fashion. A strategic approach to managing change offers the only real hope. Fortunately, some organizations have already pioneered this road of discovery.

NOTES

1. For further information on the Survey-Guided Development Process, contact: Organizational Development Research Program, Institute for Social Research, P.O. Box 1248, Ann Arbor, Michigan 48106 (Phone: 313-764-6108). For further information on the Team Productivity System, contact: The Industrial Productivity Institute, 1521 Chicksaw Drive, Naperville, Illinois 60540 (Phone: 312-420-7092).

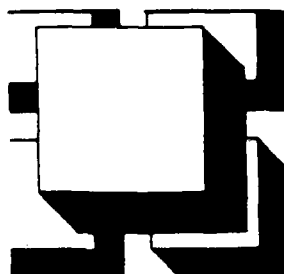
2. Eric L. Herzog, "Improving Productivity Via Organization Development," *Training and Development Journal* 34(4):38, April 1980.

3. Peter B. Vaill, "The Purposing of High-Performing Systems," *Organizational Dynamics* 11(2):29, Autumn 1982.

RESOURCES

For further reading on the subject of using an integrated strategic approach to managing change and improving organization effectiveness, the author recommends the following books: Richard Beckhard, *Organization Development: Strategies and Models* (Reading, Mass.: Addison-Wesley, 1969); Noel Tichy, *Managing Strategic Change: The Technical, Political, and Cultural Dynamics* (New York: Wiley-Interscience, 1982); and Rosabeth Moss Kanter, *The Change Masters* (New York: Simon & Schuster, 1983).

Edmund J. Metz is a senior consultant for organization effectiveness at FMC Corporation in Chicago. He is the author of a number of articles focusing on strategic human-resource planning, quality circles, and team building. He has had both consulting and management experience in executive and organization development, industrial relations, manufacturing, and quality control with GTE and Johnson & Johnson, and other corporations.



Baker, E. M. (June 15, 1987). Achieving competitive viability in the new economic age: Quality excellence in administrative, service, and support systems. Available from E. M. Baker, Director, Quality Planning and Statistical Methods, Ford Motor Company, Detroit, MI 48121.

Baker describes the challenge posed to U.S. industry today by accelerating environmental change, innovation, new rules of competition, and a greater number of viable competitors than have existed in post-war history. It becomes, then, the difficult task of management to create internal organizational changes to help meet this challenge, while maintaining the stability and effectiveness of their organizations.

Baker describes a process of continuous transformation to total organizational quality, which he calls "stable change," the process by which management may bring about internal change without inducing chaos. He believes that a key element of such an effort involves all members of organizations and that it is important that everyone work to improve the organizational systems and processes in which they work.

Baker also describes the impediments to change and improvement brought about by vertical, functionally oriented management structures that characterize most organizations today. He argues that improvement efforts have greater success when the organization is viewed as a network of customer-supplier relationships, with each processing system playing first the role of the customer and then the role of supplier. In this way, needs may be better understood and met and capabilities utilized or supplemented. In many organizations, efforts for improvement of laterally flowing processes are necessarily fragmented by their vertical, functional structures.

Baker suggests that management may enhance its organization's efforts to improve quality, productivity, and competitive position by helping its members to:

- Define the supplier-customer networks that constitute natural process teams,*
- Link the networks coherently to optimize the capability of the enterprise,*
- Manage their own processes and network relationships without intervention by others, and*
- Participate in the improvement of those processes and relationships.*

**Achieving Competitive Viability in the
New Economic Age:
Quality Excellence in Administrative,
Service and Support Systems**

Edward M. Baker, Ph.D.
Ford Motor Company

June 15, 1987

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Introduction

North American business is going through a period of explosive, accelerating change in its external environment which is increasing the demands and pressures on firms to change internal systems to more competitive ways of operating. Each year the number of technological innovations seems to double while the time for that technology to find its way into the market in the form of goods and services is shrinking -- almost halving -- from year to year.

Fifty percent of today's products and forty percent of today's services did not exist five years ago. Instant electronic communication, rapid global travel, and other forms of immediate gratification of needs are continually changing consumer expectations, habits and behavior patterns while creating a vigilance for products and services which offer the prospect of gratification of needs not yet existent.

Schon (1971) has called the phenomenon of rapid change the "loss of the stable state." Toffler (1980) has described its implications for the "generalized speedup of the corporate metabolism" and observes that many business people and executives see the certain world they once knew "tearing apart under the impact of an accelerating wave of change." Dr. Deming (1986) has provided management with a new set of principles for operating within what he describes as a "new economic age."

The Paradox of Stable Change

In order to thrive -- not just survive -- in an explosive competitive environment, the enterprise is faced with the simultaneous requirements of preventing change to maintain business as usual while making the alterations needed to stay in business for the long term. It has to be able to achieve the proper balance between maintenance of consistent, repeatable mass reproducibility of its production processes while at the same time creating a capability to continually transform any and all of its processes, systems and structures to take competitive advantage of explosive change.

The enterprise must learn how to bring about internal change without inducing chaos. Just as it must learn how to stably transform and modify resources to achieve a final product or service, transformation of the organization's transformation process also can be stable. Transformation, whether of the subject matter of the process or of the process itself, can be managed for stability. Our enterprises must be capable of bringing about and managing their own continuing transformations.

The management challenge for the new economic age is one of involving all organization members in transforming and improving the systems and processes in which they work. People's expectations about work, their role and the rewards provided by the enterprise also have changed dramatically over the decades. A large gap exists between people's potential ability and their actual commitment to perform (Yankelovitch and Immerwahr, 1983). Yet commitment must be high if people are to contribute fully their knowledge, skills, intellect and creativity to help the enterprise improve. An intimately related challenge is to create the intelligent and cooperative interaction of the multiple internal functions of the enterprise -- those internal processes

which provide the information, training, engineering, financial and other administrative services and resources to support the front line operations of manufacturing and service enterprises.

**Competitive Viability and Vertical Thinking:
Can Functionally Oriented Management Systems Do the Job?**

Competitive viability is synonymous with total organization quality, the capability to continually assess and translate customer requirements into the requirements of the organization's processes. In order for these processes to produce real value for customers, they must be unburdened with waste and resources whose sole function is to cope with expected process failures, breakdowns and problems. Each part of the process should be there to add positive value rather than remove something negative.

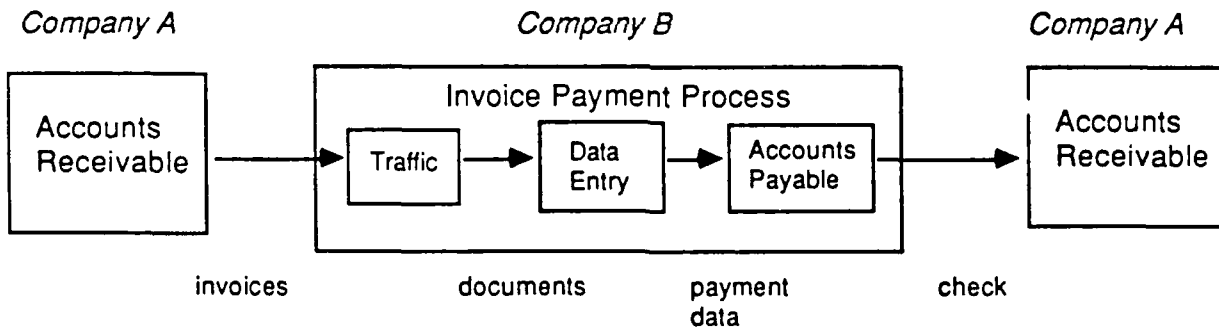
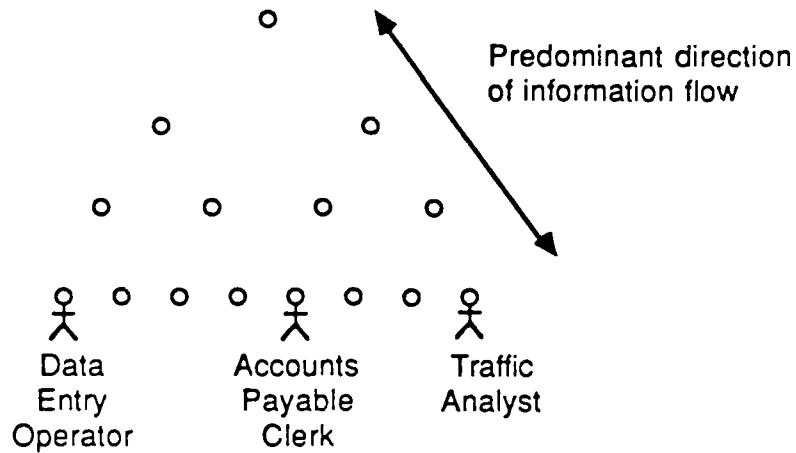
Functionally oriented, vertical management structures are faced with major obstacles to competitive quality even when everyone has the best intention, commitment, desire and philosophy. The complexity in most enterprises offers too many opportunities for the process to fail to serve customers and cultivate their sustained loyalty to the enterprise.

Exhibit 1 illustrates that deterioration of quality as product or service moves through the process stages is likely in the functionally organized hierarchy. It shows what appears to be a simple process, the payment of supplier invoices. Company A bills Company B for products and services it has provided and in turn becomes the customer of Company B's invoice payment process. This process involves three of the eight specialists at the bottom of the organization pyramid. It is likely that these individuals do not view themselves as part of a broader process or perceive their work as serving a customer. Let's say that Company A's quality requirements for payment are that the check be 1) paid on time, 2) without errors in amount or other information and 3) accompanied by accurate and complete documentation.

It is useful to look at the process as a network of supplier-customer interfaces, with each processing system playing first the role of customer/user and then of supplier/producer. Exhibit 1 shows eight ways for the process to operate. Failure to meet final customer requirements for timely, correct and complete payment and documentation can be caused by failure to meet internal customer requirements at various process stages. Each interface failure interferes with the smooth flow across process stages. It adds cost in the form of time for redo, compensation for delays, (e.g., premium mail), transmission and possible amplification of errors, loading of the communication channels with customer inquiries which have to be answered or returns which have to be reworked, as well as internal customer requests for proper information to complete the transaction. This may be done at the processing stage where it first occurs, or passed along to the final internal or external customer. The additional waste of resources in the form of inspection and checking functions (usually performed by the supervisor) that characterize poor quality processes is not shown. The demoralization that accompanies such activity also is not shown.

Exhibit 1
Process Quality Possibilities in a Functional Hierarchy

Company "B"
Traditional Vertical Structure
(Highly Simplified)



Possible
Process
Flows

Quality at the Process Interfaces

○ = ok (on time, no errors, complete, etc.)

● = $\overline{\text{ok}}$ (late, errors, incomplete, etc.)

Quality Delivered
to Final Customer

1.	○	○	○	○
2.	●	○	○	●
3.	○	●	○	●
4.	○	○	●	●
5.	●	●	○	●
6.	○	●	●	●
7.	●	○	●	●
8.	●	●	●	●

In this example, there are eight possible ways for the process to operate, seven of which will degrade quality to the final customer. Only the first process will fully meet the requirements of Accounts Receivable. If each of the eight combinations is equally likely, the final customer will be satisfied only one time in eight while being subject to errors, delays or incomplete information seven times in eight. This process, as most processes, if left to chance, will deliver poor quality more often than not. Thus, the capability of each processing stage to meet the requirements of the next customer must be assured. This implies identifying and establishing a relationship with the next customer to define the requirements and determine what is needed to meet them. Assuring the interface is difficult in the vertically structured enterprise. Setting up an internal process control feedback loop with appropriate measurements will enable the process to be managed to meet the customer's requirements once defined.

The illustration continues with Exhibit 2 which shows the elements of the accounts payable process separately embedded in the functionally structured hierarchy. It is highly simplified, depicting only three levels below the top executive and a span of control of two. Thirty-five lateral interfaces are possible. The 28 possible interfaces between the technical specialists at the bottom of the organization is more than triple the number of interfaces possible at the supervisory and management levels. Yet, traditional vertically oriented structures add complexity by requiring even more intermediaries, the bosses, which adds time and people to the process. Often, the people at the bottom of the hierarchy are not able to communicate directly with each other. They do not know with whom to communicate, or just don't have the autonomy. When you add in the vertical and diagonal interfaces, there are 105 possible two-person relationships. Some represent what should be explicit supplier-customer interfaces; others are not necessary.

Exhibit 2

Complexity in the Functional Hierarchy Inhibits Process Quality

Traditional Structure (Highly Simplified)	Level	Number of Cousins When Span of Control = 2	Potential Lateral Interfaces
o	0	$2^0 = 0$	$1(0)/2 = 0$
o o	1	$2^1 = 2$	$2(1)/2 = 1$
o o o o	2	$2^2 = 4$	$4(3)/2 = 6$
o o o o o o o o	3	$2^3 = 8$	$8(7)/2 = 28$
		14 + 1 people	35 lateral

Total number of interfaces = $n(n-1)/2 = (15)(14)/2 = 105$
(lateral + vertical + diagonal)

When the situation is made just a bit more complex (Exhibit 3) -- but still not as complex as many enterprises -- with six levels below the top and a span of control of three, one finds 1093 people, with 596,777 possible interactions. How easy is it in traditional structures to determine:

- Which interfaces are necessary?
- With whom to link? When? How often?
- Who depends on whom -- who are the customers and who are the suppliers in the potential relationship?

Exhibit 3
Proliferation of Complexity with Vertical Height (Number of Levels)
(Shown: Six Level Hierarchy with Span of Control = 3)

Level	Number of Cousins = 3 ^{Level}
0	$3^0 = 0$
1	$3^1 = 3$
2	$3^2 = 9$
3	$3^3 = 27$
4	$3^4 = 81$
5	$3^5 = 243$
6	$3^6 = 729$

Number of people = $1092 + 1 = 1093$
 Number of Interfaces = $1093 (1092)/2 = 596,778$

To further complicate matters, these questions must be answered in a dynamic, changing external environment. Furthermore, this illustration doesn't capture the intensity of the frustration and conflict that usually accompanies process failures and makes them even worse. People's feelings about the organization are intimately and intricately interwoven with its quality capability. Fragmentation of the process not only wastes large amounts of the enterprise's productive resources, but it replaces the satisfaction that comes from success with feelings of personal failure and its correlates:

frustration, blame, recrimination and conflict. People give up (most people in large organizations are not entrepreneurs and will not persist or challenge the bureaucracy when faced with adversity); they lose their commitment to the organization and their trust in management. Fragmentation of the process produces fragmentation of the spirit and loyalty to the enterprise.

Enterprise Quality and Competitive Viability: The Internal Need

The organizational complexity and its potential for fragmentation of effort (and spirit) can be overcome if functions are managed as laterally flowing processes. It also helps to understand that processes are an interaction of physical systems and people systems. However, in spite of all the technical and social change in American society, most enterprises are still structured according to mechanistic principles of operation established at the beginning of the century. Today's businesses are following management models and organization principles developed for very different economic, technological and cultural conditions. The vertically structured, functionally oriented organization was designed to cope with the needs of machines and to maintain their longevity. The system behaved as if it viewed people as consumable, expendable commodities along with other inputs to the machines. These structures, as I have argued, fragment the processes and inhibit quality. Even though most people do not want it to be that way, they seem to be unable to do anything about it. People tend to look upward to their bosses, downward to their subordinates and sideways to their cousins in other functions for the solution (or blame). The challenge to the enterprise, especially the top, is to let go of the archaic ways of thinking about how to organize the resources of the enterprise. The bureaucracy can not be restructured overnight, but certainly people can learn to operate as if they were part of an interdependent system rather than a collection of independent units.

The challenge of competitive viability is a challenge to create the internal systems and processes (and principles) capable of consistently anticipating and meeting market and customer requirements for goods and services. The internal environment of the enterprise needs a different kind of capability than in the past. While it needs sufficient internal stability to consistently reproduce goods and services for mass markets, it should be balanced by a loose enough organization that is sufficiently flexible and adaptive to respond to the demands and opportunities created by external change. People, as part of interdependent processing systems, need to have the autonomy and capability to reorganize themselves, to form and reform the process connections to meet novel and changing external conditions. As the networks reform, the specific interfaces may change along with the mutual requirements of suppliers and customers comprising the interfaces.

Management can improve the quality capability of the enterprise by helping its members to:

- Define the supplier-customer networks that constitute natural process teams.
- Link the networks coherently to optimize the capability of the enterprise.
- Manage their own processes and network relationships without intervention by others (i.e., the bosses).
- Participate in the improvement of those processes and relationships.

Moving from vertical, functionally oriented management systems and structures to lateral, process oriented ones requires a different perception of management and control; everyone in the enterprise can be viewed as a process manager. It also requires thinking in terms of wholes and relationships rather than functions and fragments; the hierarchy is one of processes and not one of functions.

Windsor Export Supply: An Attempt to Apply Process Oriented Thinking in a Service Organization

My colleague, Harry Artinian, and I have attempted to apply process oriented thinking to improve service quality within a bureaucratic, vertically oriented management structure. We were guided by Dr. Deming's management principles for the transformation (Deming, 1986). Our efforts are described in the attached paper. Other efforts to integrate the business processes are described by Kane (1986), Melan (1985), and Hermann and Baker (1985).

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SECTION III: PHILOSOPHY FOR IMPROVEMENT OF ORGANIZATIONAL QUALITY

Deming, W. E. (July 24, 1989). Foundation for management of quality in the Western World. Paper presented at the 1989 meeting of The Institute of Management Sciences (TIMS), Osaka, Japan.

Tveite, M. D. (August 22, 1989). The theory behind the fourteen points: Management focused on improvement instead of on judgement. Paper presented at the Third International Deming Users' Group Conference, Cincinnati, OH.

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Organizational change to achieve improvement in quality, productivity, and competitive position requires no less than a shift in the paradigm that governs most current management practices. This set of papers describes the assumptions that underlie current management practice and suggests to the reader assumptions that represent more closely today's competitive environment. The authors also provide a rationale for the new management practices that they propose.

Deming, W. E. (July 24, 1989). Foundation for management of quality in the Western World. Paper presented at the 1989 meeting of The Institute of Management Sciences (TIMS), Osaka, Japan.

This speech, delivered in Osaka in July 1989, represents a sample of Deming's most recent thinking and will constitute a portion of his upcoming revision of Out of the Crisis. Although the speech does not always read smoothly as a written paper, it is included here because many important and challenging ideas are discussed in it. Among these are reasons for the poor state of the American economy, the management practices that Deming believes are no longer appropriate with suggestions for more appropriate practices, and some attributes important to leaders of organizational transformation.

Thomas Kuhn, a historian of science, pointed out that major change takes place only occasionally, in what he called paradigm shifts, when the working assumptions on which people have depended become so inappropriate that they break down, to be replaced by a more appropriate set. Deming explains that many of the assumptions on which current management practice is based have broken down and that new management practices should be based on more appropriate assumptions for the new competitive environment in which American firms find themselves today.

Deming emphasizes the role of leadership and organizational innovation in the transformation and improvement of American industry. A vital role of management is to create the conditions within which people can contribute their ideas for the improvement of the company and can take pride in their work. Deming describes the environment that stimulates creativity and that gives people the power to contribute to their organizations. He argues that companies can potentially encourage innovation by the design of various organizational systems and policies, and that today the management practices of most companies stifle innovation and ignore the potential of the contribution by their employees.

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Where are we? How are we doing? Let us think about the U.S., or about all North America, not just about our own selves, nor just about our company, nor about our own community. How is the U.S. doing in respect to balance of trade? The answer is that we are not doing well.

North America has contributed much to new knowledge and to applications of knowledge. The U. S., by efficient product and natural resources, beginning around 1920 and for decades, put manufactured products in the hands of millions of people the world over that could not otherwise have had them. Our quality was good enough to create appetite for our goods and services.

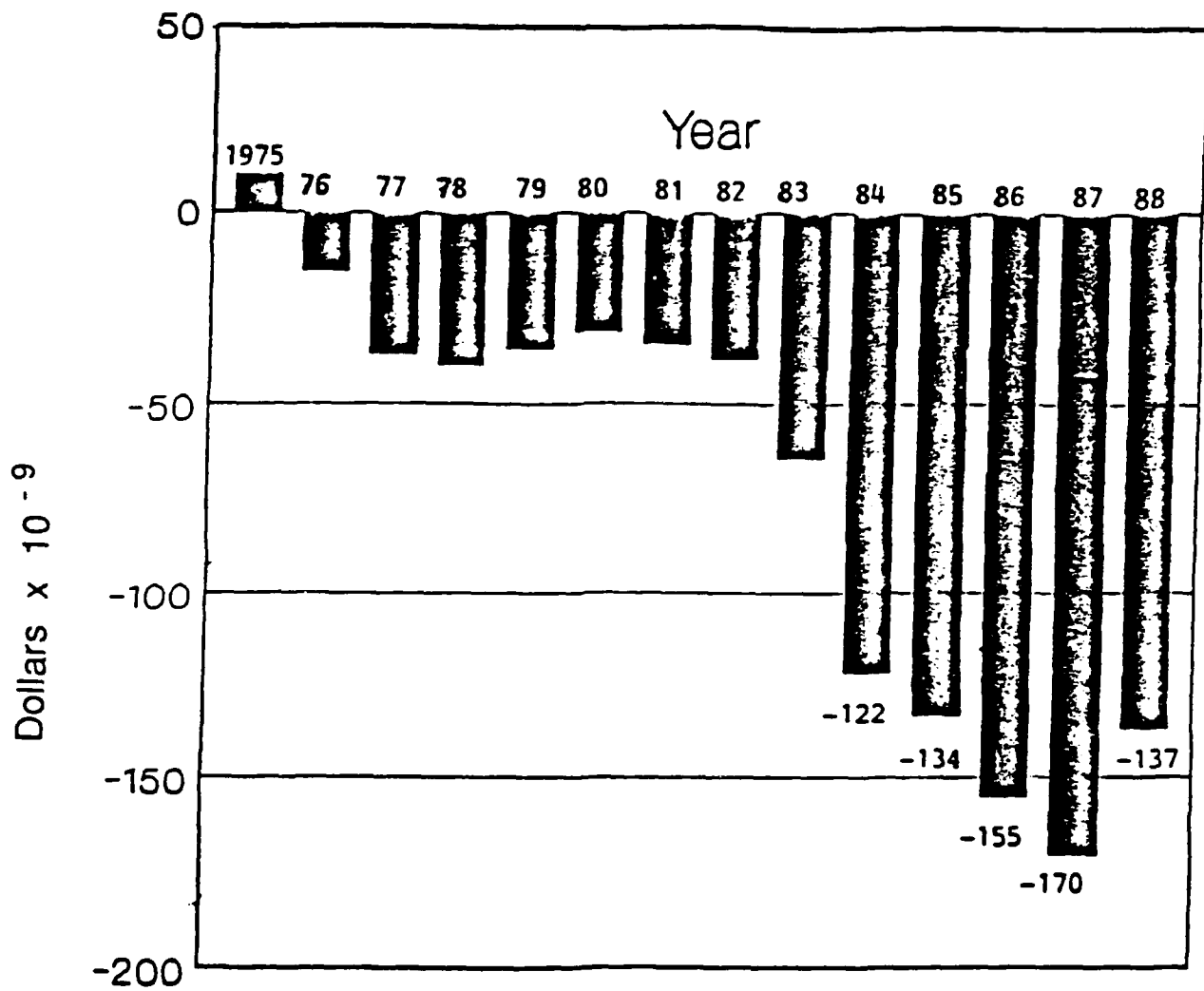
For a decade after the War, North America was the only part of the world that could produce manufactured goods to full capacity. The rest of the industrial world lay in ruins from the War. They were our customers, willing buyers. Gold flowed into Fort Knox.

Everyone expected the good times to continue and to wax better and better. It is easy to manage a business in an expanding market, and to be hopeful. In contrast with expectations, we find, on looking back, that we have been on an economic decline for three decades. It is easy to date an earthquake, but not a decline.

A paper delivered at a meeting of the Institute of Management Sciences in Osaka, 24 July 1989. Comments and help appreciated.

U. S. BALANCE OF TRADE

(MERCHANDISE)



DEPARTMENT OF COMMERCE AND BUREAU OF THE CENSUS

What happened? It is hard to believe that anything is different now than in 1950. The change has been gradual, not visible week to week. We can only see the decline by looking back. A cat is unaware that dusk has settled upon the earth, but the cat in total darkness is as helpless as any of us.

Some industries are doing better than ever. There are more automobiles in the U. S. than ever before, and more travel by air. Do such figures mean decline or advance? An answer would have to take into account that in 1958 we had inter-city trains. There was a choice, air or train. Now, we have only limited train service, air or automobile; go by air or by automobile.

There was until a few years ago a favorable balance of trade in agricultural products—wheat, cotton, soybeans, to name a few—but no longer. Imports of agricultural products have overtaken exports, and as someone in one of my seminars pointed out, if we could put illicit drugs into the accounting, our deficit in agricultural products would show up worse than the published figures.

One of our best exports, one that brings in dollars, is materials for war. We could greatly expand this income but for moral reasons. American aircraft have about 70% of the world market, and bring in huge amounts of dollars. Another big earner of dollars is scrap metal. We can't use it, so we sell it. Close on to it is scrap cardboard and paper. Timber brings in dollars. Timber is important, renewable. Equipment for construction is an important export, so I understand. American movies, a service, bring in dollars. Banking and other services were at one time important, but no longer. The biggest U. S. bank is today far down the list of biggest banks in the world. Banking

is now known mostly for losses on bad loans. (As an aside, quality in banking might be improved.)

We ship out, for dollars, iron ore, partially refined, aluminum, nickel, copper, coal, all non-renewable. Scrap metal is non-renewable.

Have we been living on fat? We have been wasting our natural resources, and worse, as we shall see, destroying our people. We need them.

Our problem is quality. Around 1958, Japanese goods started to flow in. The price was good, and the quality was good, not like the shoddy quality that came from Japan before the War and just after, cheap but worth the price. Preference for imported items—some at least—gradually climbed and became a threat to North American industry.

Were Americans caught napping? Are we still napping? Our problem is quality. Can't we make quality? Of course, and some American products are superior. We are thankful for them. Unfortunately, some good American products have little appeal beyond our borders, good paper clips, for example.

It will not suffice to have customers that are merely satisfied. A satisfied customer may switch. Why not? He might come out better for the switch.

What a company requires to get ahead is loyal customers, the customer that comes back, waits in line, and brings a friend with him.

What state of company is in the best position to improve quality? The answer is that a company that is doing well, future assured, is in excellent position to improve quality and service, thus to contribute

to the economic condition of itself and of all of us, and has the greatest obligation to improve. A monopoly is in the best position to improve year by year, and has the greatest obligation.

A look at some of the usual suggestions for quality. There is widespread interest in quality. Suppose that we were to conduct next Tuesday a national referendum:

Are you in favor of quality?

(Be honest in your answer.)

Yes ____ No ____

The results would show, I believe, an avalanche in favor of quality. Moreover, unfortunately, almost everybody has the answer on how to achieve it. Just read Letters to the Editor, speeches, books. It seems so simple. Here are some of the answers offered, all insufficient, some negative in results.

Automation

New Machinery

Computers

Gadgets

Hard work

Best efforts

Make everybody accountable

M.B.O., management by objective, management by
the numbers, actually tampering

M.B.R., management by results

Merit system (actually, destroyer of people)

Incentive pay. Pay for performance.

Work standards (quotas, time standards)

They double the cost of production be they
for manufacturing or for service (bank,
telephone company).

They rob people of pride of workmanship,
the emphasis being on numbers, not on
quality.

They are a barrier to improvement.

Just in time

Zero defects

Meet specifications

Motivate people

Some remarks. The fallacies of all the suggestions listed above will be obvious from subsequent pages of the text. Every one of them ducks the responsibility of management, requiring only skills, not knowledge about management.

If the reader could follow me around in my consultations, he would perceive that much automation and much new machinery is a source of poor quality and high cost, helping to put us out of business. Much of it, if it performs as intended, is built for twice the capacity that is needed. Some of it is poorly designed, such as: make + inspect + make inspect + make inspect + ..., where inspection may not be economically the best procedure. (See Ch. 15 in OUT OF THE CRISIS.) Moreover, the apparatus for inspection usually gives more trouble than the apparatus for make.

Just in time, along with low inventory, is good, of course. Unfortunately, efforts usually start at the wrong end. The place to start is with processes and movements of materials used. Once processes and movements are in statistical control, the plant manager will know how much of this and that that he will need by 3 o'clock tomorrow. Quantity and quality will be predictable.

Zero defects, meet specifications, incoming and outgoing, are not good enough. Of course, we wish not to violate specifications, but to meet specifications is not enough. The pieces in an assembly must work together as a system. Assemblies must work together as a system. I may refer to page 476 in the book, OUT OF THE CRISIS.

Principle 3. Tests of components in stages of development can not provide (a) assurance that they will work together satisfactorily as a system in service; nor (b) the average run between failures of the system; nor (c) the type and cost of maintenance that will be required in service.

A company advertised that the future belongs to him that invests in it, and went ahead and spent \$45,000,000,000 for new machinery. Most of it turned out to be a binge into high costs and low quality, but it must be said in defense of the management that they were obviously taking a long view into the future, not trying to capture short-term profits.

Why do the above suggestions fall short? A little ingredient that I call profound knowledge is missing from all the above suggestions. There is no substitute for knowledge. Hard work and best efforts will by themselves not produce quality nor a market. We shall soon come to suggestions for the missing ingredient, profound knowledge.

One could announce an important theorem: we are being ruined by best efforts directed the wrong way. We need best efforts directed by a theory of management.

Wrong way. The President of a company put quality in the hands of his plant managers. The results in time became obvious and embarrassing. Quality went down, as was predictable. A plant manager can not possibly know what quality is, and even if he did, he could do nothing about it. He is helpless. He can only try to do his job, and to confirm specifications.

The President of a company wrote that

Our people in the plants are responsible
for their own product and for its quality.

They are not. They can only try to do their jobs. Their product and its quality are the responsibility of the man that wrote the article, the President of the company.

The management of a company put this slogan in the hands of all employees:

The operator is responsible for the quality
of our products. The inspector shares this
responsibility.

Again, the operator is not responsible for the quality of his product. The product is the responsibility of the management. Moreover, responsibility divided between operator and inspector, as it is here, assures mistakes and trouble.

The management in both of these examples rid themselves of their responsibility by handing it over to people that are helpless to define quality and to improve processes. Another example: a group of consultants in management advertised thus:

Computerized quality information systems
provide the vital link between high technology and effective decision making.

I wish that management were as simple as that.

The big losses. Too often, the financial people in a company merely beat down costs, on the thought that any cost is too high. Why do they write cheques for machinery that violates good practice?

It is vital for management to manage the big losses. One should of course chase the nickels and dimes, but it is futile to chase nickels and dimes and at the same time neglect the biggest losses. The biggest losses, as Dr. Lloyd S. Nelson said years ago, are unknown and unknowable. Most of them are not even under suspicion.

What are the big losses? Answer: the so-called merit system—actually, destroyer of people; M.B.O., management by the numbers, quotas, failure to optimize the various activities and divisions of a company as a system, business plans in terms of a matrix of targets without regard to the whole plan as a system of improvement. Further losses come from:

Worker training worker.

Executives working with best efforts, trying to improve quality, the market, and profit, but working without guidance of profound knowledge.

Tampering.

Failure to optimize efforts of people and divisions within the company, accepting, instead, suboptimization—everyone trying to maximize the profits of his own division—and the consequent losses.

Failure of customers and suppliers to work together for ever greater and greater satisfaction of quality, lower costs, everybody win.

Knowledge about the Taguchi loss function is necessary for management. Which quality-characteristic is most critical? It is management's job to discover which quality-characteristic is most critical, conquer it, then to move on to the next one.

Where is quality made? The answer is, in the top management. The quality of the output of a company can not be better than the quality directed at the top.

The people in the plants and in service organizations can only produce at best the design of product and service prescribed and designed by management.

Job security and jobs are dependent on management's foresight to design product and service that will entice customers and build a market.

Profound knowledge. Hard work and best efforts, put forth without guidance of profound knowledge, may well be at the root of our ruination. There is no substitute for knowledge. What is profound knowledge? An attempt to supply some answers follow.

A SYSTEM OF PROFOUND KNOWLEDGE

1. Knowledge for study of variation. Variation there will always be, between people, output in service and of product. What is the variation trying to tell us?

2. Knowledge of variation helps us to understand the losses from tampering. There are two mistakes (p. 318).

1. Treating a fault, complaint, mistake, accident, as if it came from a special cause when actually it came from common causes.

2. The converse.

3. Knowledge of procedures aimed at minimum economic loss from these two mistakes. (Shewhart control charts.)

4. Knowledge about interaction of forces. Effect of the system on the performance of people.

Dependence, inter-dependence between people, groups, divisions, companies, countries.

5. Losses from demands that lie beyond the capability of the system (e.g., M.B.O.).

6. Knowledge about loss functions, in particular the Taguchi loss function. Which quality-characteristic is most critical for management to work on?

7. Knowledge about the production of chaos and loss that results from successive application of random forces that may individually be unimportant. Examples:

Worker training worker.

Executives working together on policy without guidance of profound knowledge.

Committees and government agencies working without guidance of profound knowledge.

8. Losses from competition for share of market.

Losses from barriers to trade.

9. Some knowledge about the theory of extreme values.

10. Some knowledge about the statistical theory of failure.

11. Theory of knowledge:

a. Any plan, however simple, requires prediction.

b. There is no knowledge without theory.

c. There is no knowledge without prediction.

d. Experience teaches nothing unless studied with the aid of theory.

e. An example teaches nothing unless studied with the aid of theory.

f. Operational definitions: communication.

g. No number of examples establishes a theory.

h. There is no true value of anything.

i. There is no such thing as a fact. Any two people have different ideas about what to record about what happened.

12. Knowledge of psychology.

Intrinsic motivation (for innovation, for improvement, for joy in work, for joy in learning).

Extrinsic motivation (humiliating, a day's pay for a day's work).

Overjustification: reward for an act or achievement that brought happiness to the doer, for the sheer pleasure of doing it. The result of reward is to throttle repetition. He will never do it again.

13. People learn in different ways, and at different speeds.

14. Necessity for transformation (government, industry, education) to leadership within the company; elimination of competition, ranking people, grades in school, and prizes for athletics in school.

15. Knowledge about the psychology of change.

Effects of the present system of management. The accompanying diagram shows some of the present norms of management, and their effects. What they do is to squeeze out from an individual, over his life-time, his innate intrinsic motivation, self-esteem, dignity, and build into him fear, self-defense, extrinsic motivation. We have been destroying our people, from toddlers on through the university, and on the job.

Transformation is required in government, industry, education. Management is in a stable state. Transformation is required to move out of the present state. The transformation required will be a change of state, metamorphosis, not mere patchwork on the present system of management. We must of course solve problems and stamp out fires as they occur, but these activities do not change the system.

The transformation will take us into a new system of reward. We must restore the individual, and do so in the complexities of interaction with the rest of the world. The transformation will release the power of human resource contained in intrinsic motivation. In place of competition for high rating, high grades, to be No. 1, there will be cooperation on problems of common interest between people, divisions, companies, government, countries. The result will in time be greater innovation, applied science, technology, expansion of market, greater service, greater material reward for everyone. There will be joy in work, joy in learning. Anyone that enjoys his work is a pleasure to work with. Everyone will win; no loser.

The diagram that follows portrays the effect on the individual from the prevailing system of reward. The transformation set forth in this paper will year by year build up the bottom half and shrink the upper half.

The function of government will be to assist business, not to harass business.

Life begins

Grading in school
School athletics for
gold stars

Merit system. Judge
people; put them into
slots

Incentive Pay. Pay
for performance

M.B.O. Mgt by
the numbers

Business plans in
terms of targets

Quotas for daily
production

Suboptimization.
Competition between
people, divisions, groups.
I win, you lose every-
body, you lose every-
one.

Life ends

These forces create fear, self-defense, competition, humiliation.

Competition for highest grade in school. Play to win, not for fun. Learning and joy in learning are smothered. Beaten, humiliated, he drops out of school; turns to selling drugs; jail. On the job, strive for high rating.

Extrinsic motivation (a day's pay for a day's work) crowds out intrinsic

motivation, self-esteem, dignity, joy in work.

The forces shown smother year by year the intrinsic motivation, self-esteem, dignity, that one is born with. They rob people of joy in work, and joy in learning. He that enjoys his work is a joy to work with.

The forces along the top rob the company and the nation of innovation and applied science.

Gradual ruination over the life span of the individual from the prevailing system of reward in education, industry, and government.

Leadership. In place of judgment of people, rating them, putting them into slots (outstanding, excellent, on down to unsatisfactory), there will be leadership. The aim of leadership is to help people, to improve the service and profits of a company.

SOME ATTRIBUTES OF A LEADER

1. A leader understands how the work of his group fits in to the aims of the company. The purpose of this group is to support these aims.

2. He works in cooperation with preceding stages and with following stages toward optimization of the efforts of all stages. He sees his group as a link in a system. (See page 87 of the text.)

3. He tries to create for everybody interest and challenge, and joy in work. He tries to optimize the education, skills, and abilities of everyone, and helps everyone to improve. Improvement and innovation are his aim.

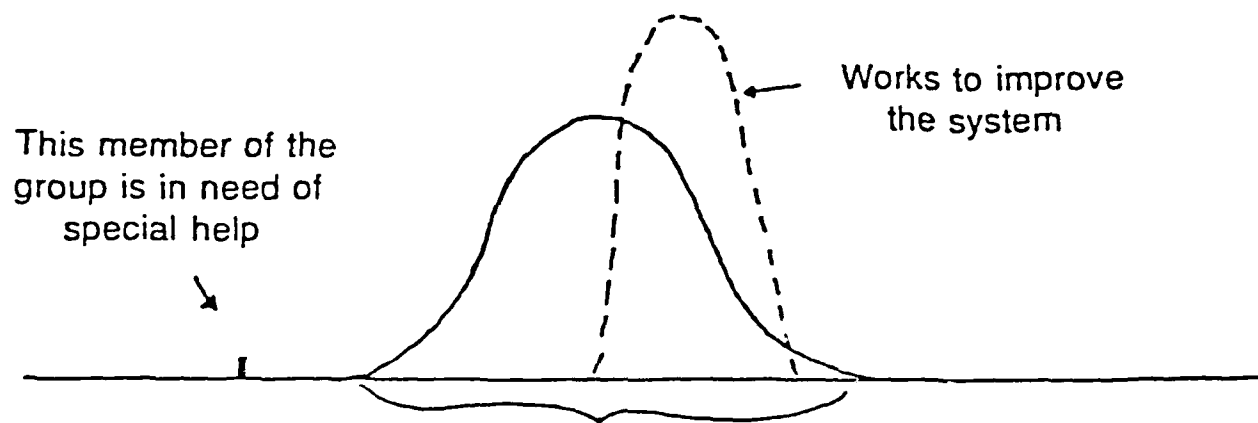
4. He is coach and counsel, not a judge.

5. His source of power is:

1. Formal 2. Knowledge 3. Personality

A successful leader develops 2 and 3; does not rely on No. 1. He has nevertheless obligation to use No. 1, as this source of power enables him to change the system--equipment, material, methods--to bring improvement, such as to reduce variation in output. (Dr. Robert Klekamp.)

6. He uses plots of points and statistical calculation with knowledge of variation, to try to understand the performance of himself and of his people. One aim is to try to learn how he himself can improve his leadership. Another aim is to learn who if anybody is outside the system. Simple re-arrangement of the work might be the answer. Transfer to another job may require prudence and tact, as the man to be transferred may interpret this as one way to get rid of him.



These people must not be ranked

7. He creates trust. He creates freedom and innovation. He is aware that creation of trust requires that he take a risk (Carlisle & Parker, BEYOND NEGOTIATION, Wiley, 1989).

8. He does not expect perfection.

9. He listens and learns without passing judgment on him that he listens to.

10. He understands the benefits of cooperation and the losses from competition (Alfie Kohn, NO CONTEST, Houghton Mifflin, 1986).

More on pages 117 and 118 of OUT OF THE CRISIS.

The most important figures for management are unknowable. It was Dr. Lloyd S. Nelson who years ago remarked that the most important figures for management are unknown and unknowable. We could add that figures for most important losses and gains are not even under suspicion. Examples:

1. The merit system, putting people into slots, a lazy way out: actually, destroyer of people.
2. Failure to understand leadership.
3. Worker training worker.
4. Executives working with best efforts, trying to improve quality, the market, and profit, but working without guidance of profound knowledge.
5. Tampering.
6. Failure to optimize efforts of people and divisions within the company, accepting, instead, suboptimization—everyone trying to maximize the profits of his own division—and the consequent losses.
7. Failure of customers and suppliers to work together for ever greater and greater satisfaction of quality, lower costs, everybody win.
8. Gains in quality and productivity throughout the rest of the company from improvement in one stage.

Some faulty practices with suggestions on better practice

FAULTY PRACTICE	BETTER PRACTICE
<p>Reactive: skills only required, not theory of management. M. B. R. (management by results). Mind not required.</p>	<p>Theory of management required</p>
<p>Management of outcome, too late; tampering; failure to distinguish between special causes and common causes. Immediate action on</p> <ul style="list-style-type: none"> Costs Complaints from customers Poor quality, in or out Accidents Emergency breakdowns Absenteeism 	<p>Work on the system, to reduce failure at the source. Costs are not causes. Likewise for complaints from customers, poor quality, accidents, emergency breakdown, absence. Avoid tampering. Instead, distinguish by appropriate techniques between special causes and common causes.</p>
<p>The so-called merit system--actually, destroyer of people.</p>	<p>Change the system of reward from rugged individualism--I win, you lose--to cooperation, everybody win. Institute leadership.</p>
<p>Incentive pay for the individual. Pay based on performance. The incentive is numbers, not quality. Result: back-fire, loss.</p>	<p>Put all people on regular systems of pay. Provide leadership.</p>
<p>PRR, problem report and resolution. Actually, this system of management by results is tampering, making things worse.</p>	<p>Study the system. Practice methods by which to minimize the net economic loss from the two mistakes:</p> <ol style="list-style-type: none"> 1. Ascribe any fault, complaint, mistake, accident, to a special cause when in fact it came from common

Continued

FAULTY PRACTICE

Reactive: skills only required, not theory of management. Mind not required.

BETTER PRACTICE

Theory of management required

Work standards (quotas, time standards). They

1. Double costs.
2. Rob people of pride of workmanship.
3. Are a barrier to improvement of a process.
4. Shut off any possibility to obtain data to use for improvement of output. This is so because the figures on production are forced.

M.B.O., management by the numbers. (Do it, I don't care how you do it. Just do it.)

A company will of course have aims; likewise an individual will have aims. But the aim should be improvement of the system, not a number.

There are of course facts of life. Example: if we don't decrease faulty product to 5% by the end of the year, we shall not be here. This is not M.B.O.

Provide leadership. Everyone is entitled to pride of workmanship. Wherever work standards have been replaced by competent leadership, quality and productivity have gone up, and people on the job are happier.

A better way is to improve the system to get better results in the future. One will only get what the system will deliver. Any attempt to beat the system will cause loss. (See pronouncement of Dr. Nelson on page 20 of the text.)

What should a school of business teach? The answer is, I believe, that a school of business ought to teach profound knowledge. A school of business has the obligation to prepare students for the future, not for the past. As constituted, most schools of business teach students how business is conducted, and how to perpetuate the present system of management--exactly what we don't need. Most of the time that students spend in a school of business today is to learn skills, not knowledge.

A school of business has an obligation to prepare students to lead the transformation that will help our balance of trade and our economy. A school of business has an obligation to teach profound knowledge as a system.

There would of course be elective courses in the curriculum for business, such as a language (two years or more), history, physics, chemistry, biology, geography, anthropology, economics. Some students might wish to take their elective courses in more statistical theory, or in psychology, or in the theory of knowledge.

Tveite, M. D. (August 22, 1989). The theory behind the fourteen points: Management focused on improvement instead of on judgment. Paper presented at the Third International Deming Users' Group Conference, Cincinnati, OH.

Tveite explains the theoretical context which underlies Deming's fourteen points. The fourteen points are not separate assertions about management practice made by Deming; rather, they are all implied by statistical theory. Tveite provides his reader with an understanding of the distinction between enumerative and analytic studies, and asserts that an appreciation of the difference between the two is essential in understanding the fourteen points.

The paper is a very readable and enlightening aid to students of Deming's philosophy of management and to those whose job it is to evaluate and bring change to management practice.

**The Theory Behind the Fourteen Points: Management
Focused on Improvement Instead of on Judgement**
Presented at the Third International Deming Users' Group Conference
Cincinnati, Ohio
August 22, 1989
Michael D. Tveite

Many organizations are concluding that quality is critically important to them. Some believe it can provide a strategic advantage for them, while others see it as a requirement for survival. In pursuit of improving quality, many organizations have chosen to follow the management philosophy of Dr. W. Edwards Deming as embodied by his fourteen points for management.

In order for the fourteen points to help these organizations, they need to understand what the points mean in general, and for them in particular. The fourteen points are not completely black and white; there are many interpretations possible for them. However, there is a single, unifying theory which lies behind the fourteen points. Understanding this theory will aid in understanding Dr. Deming's intent for each of the points. Then, as the points are applied in the context of a company, their intent can be preserved. The purpose of this paper is to discuss the theory behind the fourteen points and then to examine each of the points in light of the theory.

The Theory Behind the Fourteen Points

Driving a car as an analogy to management

When I was learning to drive a car, I focused on the position of the car in the road. I did this by aligning a spot on the hood of the car with the center line of the road.

One day not long after I got my learner's permit, my father was riding with me. We came over the top of a hill with the road visible ahead of us for several miles. Several seconds later, my father asked me how many bicyclists were up ahead. I glanced up to see several bicyclists almost a mile away. I counted them as quickly as I could (not wanting my father to know I had not seen the bicyclists at all until he asked me about them) and responded "four." He corrected me; there were five bicyclists. He used the opportunity to encourage

me to focus as far ahead as I possibly could to watch out for potential hazards including traffic, pedestrians, bicyclists and changes in the road itself. His assertion was that if you knew where you were going and were aware of potential hazards ahead, you did not need to worry about your current position on the road; rather, the forward focus would keep you where you wanted to be on the road at any time.

When I was sixteen I did not fully appreciate the wisdom of his words. In retrospect, by focusing ahead, you are actually better able to control where you are on the road right now. If your focus is on your current position, you will constantly be making small adjustments to the steering wheel, actually overreacting and increasing the variability of your position. Also, if there are any hazards ahead, you will not be aware of their presence until they are upon you. Then you will have to take drastic action, swerving or slamming on your brakes to avoid the hazard, putting you at risk of losing control of your car. However, if your focus is ahead, you will become aware of potential hazards early so that by the time you reach them you can slow down and prepare to avoid them in a careful, thought out way.

I believe Dr. Deming's message for managers is the same as my father's message for me: focus ahead, looking for potential hazards and their impact. With this focus ahead, you will be well able to lead your organization into the future. The rest of this paper is an elaboration of this message, first discussing the theory which provides a basis for the analogy and then addressing the fourteen points as the application of this message to different parts of a business.

Analytic vs. Enumerative studies

Dr. Deming is a statistician. Much of his work is in statistical theory, and it is statistics that provides the theory behind the fourteen points. Deming (1950, Chapter 7) introduced concepts he labeled enumerative and analytic statistical studies. In any statistical study the ultimate aim is to provide a rational basis for action. Enumerative and analytic studies differ by where the action is taken. Deming (1975) summarized the distinction between enumerative and analytic studies as follows:

Enumerative study: A statistical study in which action will be taken on the material in the frame being studied.

Analytic study: A statistical study in which action will be taken on the process or cause-system that produced the frame being studied, the aim being to improve practice in the future.

(In a statistical study, the frame is the set from which the sample is taken.)

In other words, an enumerative study is a statistical study in which the focus is on judgement of results and an analytic study is one in which the focus is on improvement of the process or system which created the results being evaluated and which will continue creating results in the future. A statistical study can be enumerative or analytic, but it cannot be both.

This distinction between enumerative and analytic studies is the theory behind the fourteen points. Dr. Deming's philosophy is that management should be analytic instead of enumerative. In other words, management should focus on improvement of processes for the future instead of on judgement of current results.

The Fourteen Points in Light of the Theory

Based on the theory from the last section, each of the fourteen points is telling managers either to stop focusing on judgement of results (i.e. stop managing enumeratively) or start focusing on improvement of the processes that create the results (i.e. start managing analytically). In this section, each of the fourteen points will be characterized in one of these two ways and grouped with related points.

Purpose

Start focusing on improvement of process:

- Point 1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.
- Point 14. Put everybody in the company to work to accomplish the transformation.

With constancy of purpose, management designs products, services and processes to meet the needs of the customer, both now and in the future. Management also initiates efforts to continually improve the products and processes of the organization. When top management establishes constancy of purpose, it creates an environment where everyone in the organization works toward the purpose, allowing the organization to move in a single direction with a longer term focus.

Point 14 says to put everybody to work to accomplish the transformation. Everyone in the company has something to contribute to improvement. The people who are closest to a process have the most knowledge about it. This is true whether the process is a senior management level process or whether it is a clerical or administrative process. Therefore, to improve all facets of the business, all of the resources of the company need to be used.

Leadership

Stop focusing on judgement of results:

Point 11. Eliminate work standards and quotas. Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute leadership.

Point 12. Remove barriers that rob people of their right to pride of work. This means abolishment of the annual or merit rating and of management by objective, management by the numbers.

Point 8. Drive out fear, so that everyone may work effectively for the company.

Start focusing on improvement of process:

Point 7. Institute leadership. The aim of leadership should be to help people and equipment and gadgets to do a better job.

Consider Points 11 and 12 in light of the theory: Stop focusing on judgement of results and begin focusing on improvement of processes which yield the results.

When Dr. Deming, in Point 11, speaks of eliminating management by objective, a common perception is that he is

advocating elimination of numbers to manage the business. What this point is addressing is focus on the number instead of on the process to get the number. When Dr. Deming speaks of management by objective, management by the numbers, he means the practice which says, "here is the number. Get the number. I do not care how you get it, just get it." If this is the focus, the number is sometimes attained at great expense to some other part of the company.

Consider, instead, the following process. A company needs to plan, and they need numbers for their plans. A manager and one of her people meet to discuss projected requirements of their area for the next year. There may be a number attached to the projected requirements. Jointly, using their combined knowledge of the processes in their area, they make plans which they expect will allow them to meet the projected requirements. In their daily relationship, the focus should be on the plans and ensuring their execution rather than on meeting the requirements.

Information about how well they are able to meet requirements can be gathered, but failure to meet requirements could reflect on either execution of the plan or on the plan itself. If they have worked together to ensure proper execution, the information is feedback to the planning process. This feedback should be added to their knowledge and used to improve the planning process. Missing a plan number should not be cause for focusing on whose fault it was that the number was missed. When the focus is on blaming someone, information which could be used to aid improvement is often missed, ignored or distorted. Instead, missing the number, although not desirable, should be viewed as an opportunity to learn something which will help improvement of the process for the future.

As with Point 11, people often misunderstand what Dr. Deming means by Point 12. Point 12 includes, among other things, elimination of performance appraisal. A common response is, "eliminate performance appraisal? That means we don't talk to our employees, we don't give them feedback, we don't tell them when they are having problems, when they are doing a bad job?" It does not mean any of those things. There are several elements involved in performance appraisal. Examine the elements in light of the theory and ask where there is focus on improvement of processes and where there is focus on judgement of results. The theory calls for elimination of the elements of performance appraisal which focus

on judgement of results. Primarily, Dr. Deming is talking about eliminating the rating and ranking of people. He contends that neither rating nor ranking contribute to improvement of performance in the future.

Fear is a result of management practices like those discussed in Points 11 and 12. People become fearful when management sets targets and creates evaluation and reward systems that penalize those that do not make the targets, regardless of the capability of the processes that they work in. Fear of failure and fear of making mistakes stifle creativity; to be creative and try something new is a risk, it is much safer to do what has always been done. When the bad practices are eliminated, fear will decrease.

Points 11 and 12 have been described as practices that focus on judgement of outcomes and they should be stopped, according to Deming. What does Dr. Deming propose as an alternative to these things? Deming (1989) says that managers or supervisors must become leaders. He lists attributes of leaders:

1. They understand how the work of their group fits in to the aims of the company.
2. They work with preceding stages and with following stages.
3. They try to create for everybody joy in work. They try to optimize the education, skills, and abilities of everyone, and help everyone to improve.
4. They are coaches and counsellors, not judges.
5. They use figures to help them understand their people and themselves. They understand variation. They use statistical calculation to learn who if anybody is outside the system, in need of special help.
6. They work to improve the system that they and their people work in.
7. They create trust.
8. They do not expect perfection.
9. They listen and learn.

Cooperation, the economics of win-win

Stop focusing on judgement of results:

- Point 9. Break down barriers between departments.
- Point 4. End the practice of awarding business on the basis of price alone.

Start focusing on improvement of process:

- Point 2. Adopt a new philosophy.

When Dr. Deming talks about adopting a new philosophy, many people become confused about what the new philosophy is. Deming (1986, 1989) says the new philosophy is a change of focus from quantity to quality, from management of results to improvement of processes, from fierce internal competition to cooperation among all functions in the company to enable it to achieve the purpose of the organization. The new philosophy is based on the economic benefits of establishing win-win relationships.

Management practices focused on judgement of results create barriers between departments. When the focus is on results, there is a tendency to get a good result for your area regardless of what it does to another area. When there are practices which focus on the results of each area, the local results become more important than the company results, and there is no constancy of purpose. Instead, management practice should create teamwork and cooperation throughout the company, with everyone focusing on the purpose of the company.

This new philosophy of quality and cooperation extends to relationships with customers and suppliers. Point 4 calls for an end to awarding business on the basis of price alone. Instead, award business on the basis of total cost, including cost of use, service, and repair. Further, work with suppliers should be based on long term relationships of loyalty and trust.

Training and education

Start focusing on improvement of process:

Point 6. Institute training on the job.

Point 13. Institute a vigorous program of education and self improvement.

Points 6 and 13 are related. The difference lies in their scope. Point 6 has a focus on training in skills and knowledge related to a specific job or task, with the objective of helping the trainee do the job better. This training includes discussion of how the work fits in to the larger processes, and why it is important, as well as description of the work and how to carry it out.

Point 13, on the other hand, deals with education of the workforce in any subject. This education is intended to stimulate the employees and to increase their ability to think in innovative ways about the company, their position, and opportunities for improvement. It is intended to build employees' self esteem and self confidence, to help them become a more valuable and valued member of the company.

Both of these points are focused on helping people improve themselves and their ability to do a better job. Training and education are tools leaders can use to help people improve.

Improvement of processes

Stop focusing on judgement of results:

Point 3 Cease dependence on inspection to achieve quality.

Point 10 Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity.

Start focusing on improvement of process:

Point 5 Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.

Dependence on inspection to achieve quality focuses on improvement of results by examining the results, judging them, and

separating good from bad results after they are created but before the customer sees them. This is an expensive and ineffective way to get quality. It is expensive because it involves rejection or rework of results which have cost the company. Also, the inspection or audit itself is very costly. It is ineffective because no inspection or audit system detects every bad result; no matter how much is spent on inspection, bad results still get to customers. Point 3 calls for its elimination.

Since it is expensive and ineffective to sort good from bad, the focus needs to be on preventing bad results from occurring. However, if the prevention takes the form of slogans, exhortations, and targets aimed at getting the people to work harder or better, it is still a practice focused on judgement of results. In this case, the judgement is assuming people are responsible for the bad results. Point 10 calls for elimination of slogans and exhortations.

Instead of these practices which focus on judgement, Point 5 says to "improve constantly and forever the system of production and service." This is done, not by focusing on results, but rather by focusing on and understanding the cause system which creates the results, with a view to improving it for the future.

Summary

The purpose of this paper was to discuss the theory behind Deming's fourteen points and then to examine each of the points in light of the theory. The reason to do this comes from a desire to help people follow the Deming philosophy, embodied by the fourteen points. However, to follow the Deming philosophy, people must be understand the philosophy in their own business. The presumption was then made that in order to gain this understanding, it is important to understand the theory that is behind the fourteen points.

The theory behind the fourteen points is that management should be focused on improvement of processes instead of being focused on judgement of results. In light of this theory, the fourteen points were classified as advocating either "stop focusing on judgement of results" or "start focusing on improvement of process," and the points were grouped with other, related points. A summarization of the grouping and classification appears below:

Title for group of pts.	Start focusing on improvement of process	Stop focusing on judgement of results
Purpose	1. Create constancy of purpose. 14. Put everybody to work to accomplish the transformation.	
Leadership	7. Institute leadership.	11. Eliminate numerical goals and quotas. 12. Remove barriers to pride of work. 8. Drive out fear.
Cooperation	2. Adopt a new philosophy	9. Break down barriers between departments. 4. End the practice of awarding business on the basis of price alone.
Training & Education	6. Institute training on the job. 13. Institute a vigorous program of education and self improvement.	
Improvement of processes	5. Improve constantly and forever the system of production and service.	3. Cease dependence on inspection to achieve quality. 10. Eliminate slogans and exhortations.

Table 1. Classification and grouping of Deming's fourteen points.

If the reader has gained an understanding of the theory behind the fourteen points, they can now begin to understand how the Deming philosophy applies to their business and to their own job and should strive to follow it.

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Joiner, B. L. (1985). Total quality leadership vs. management by results. Available from Joiner Associates, Inc., P.O. Box 5445, 3800 Regent St., Madison, WI 53705-0445.

Joiner describes a system of management for the improvement of quality, productivity, and competitive position of a company, a system he calls "Total Quality Leadership." He suggests that improvement efforts are more effective if they are focused on the processes by which work gets done rather than on areas of functional or individual accountability. Key components of "Total Quality Leadership" are:

- A recognition that at least 85 percent of the failures in any organization are the fault of systems controlled by management. Thus the focus is on constant improvement of systems in organizations.*
- A realization that work is not haphazard. It must be improved through a process of study and analysis.*
- An understanding of variation and its components to guide the type of managerial action.*
- Emphasis on improvement of processes rather than on individual accountability.*
- Improved relations with suppliers, the establishment of a true working relationship between customer and supplier.*
- Constancy of purpose throughout the organization.*

Joiner provides the reader with guidelines for further study of the quality philosophy.

Joiner

Total Quality Leadership Vs. Management by Results

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Dr. Brian L. Joiner is a leading consultant to corporate executives on managing for rapid, continuous improvement. He is also the co-founder and CEO of Joiner Associates Inc., a firm engaged in management consulting and software development.

With more than 20 years' experience as a consultant and entrepreneur, Dr. Joiner has first-hand knowledge of the market forces affecting managerial actions. He is a world-renowned proponent of quality management principles, especially the teachings of Dr. W. Edwards Deming. His work with top executives from small and large corporations—including *Fortune* 100 firms—has centered on weaving their key business concerns into long-term plans for achieving world-class quality and productivity. The new economic era, he says, requires a change in the role of top managers. New knowledge is needed to help top managers work with their employees to improve the key systems that create organizational excellence.

Dr. Joiner has been giving in-house and public seminars on quality management for over six years and is frequently invited to keynote major national quality conferences. He is the author of numerous publications, including "The Key Role of Statisticians in the Transformation of North American Industry," "Total Quality Leadership vs. Management by Results" (co-written with Peter Scholtes). He also made major contributions to the Joiner publication *The Team Handbook: How to Use Teams to Improve Quality*. He holds bachelor's degrees in industrial engineering and accounting from the University of Tennessee, and an M.S. and Ph.D. in statistics from Rutgers University. He has received awards from both the American Society for Quality Control and the American Statistical Association. In December 1987 he received the W. Edwards Deming Medal at the 43rd Annual Conference on Applied Statistics.

TOTAL QUALITY LEADERSHIP VS. MANAGEMENT BY RESULTS

Brian L. Joiner

I. Introduction

America faces a deeply troubling future.

We are in the midst of a transition to a world economy increasingly dominated by the Pacific Basin countries, a turnaround in the economy from the red-hot inflation years of the late 1970s, and a revolution in technology that is altering battle plans on nearly every front every day. America is struggling in a world where companies, governments and organizations have to run fast and smart to stay alive.

Many American companies are in trouble—losing old customers and failing to find new ones. Yet many managers can not comprehend what is happening or why it is taking place.

Manufacturers have been hurt badly by foreign competition that is producing higher quality goods at lower prices. Many firms—both manufacturing and service companies such as airlines and banks—are facing chaotic market conditions as a result of deregulation. State and local governments, already subject to cutbacks of federal funds, struggle to make up revenues through higher taxes. State is pitted against state in fierce competition to attract new jobs.

We believe that one major cause of these problems is the failure of American managers to realize that there is a “new” way to manage their organizations—a way that yields much higher quality, higher productivity, more jobs and better return on investment.

We call this system of management Total Quality Leadership.

Total Quality Leadership is a way of managing any organization—whether it be a Fortune 500 corporation, a university or a family restaurant. Total Quality Leadership can create sustained growth from the chaos of today's marketplace. With Total Quality Leadership practiced throughout the economy, America can regain its competitive position in the world market.

All managers have a job to do to help their companies learn and implement the new approach. In this article, we will describe the new approach to management which needs to be practiced by the entire organization. And then we will give some details about what individual managers can do to help implement these changes. First we will examine what we call “Management by Results,” the most common form of management practiced in American companies today.

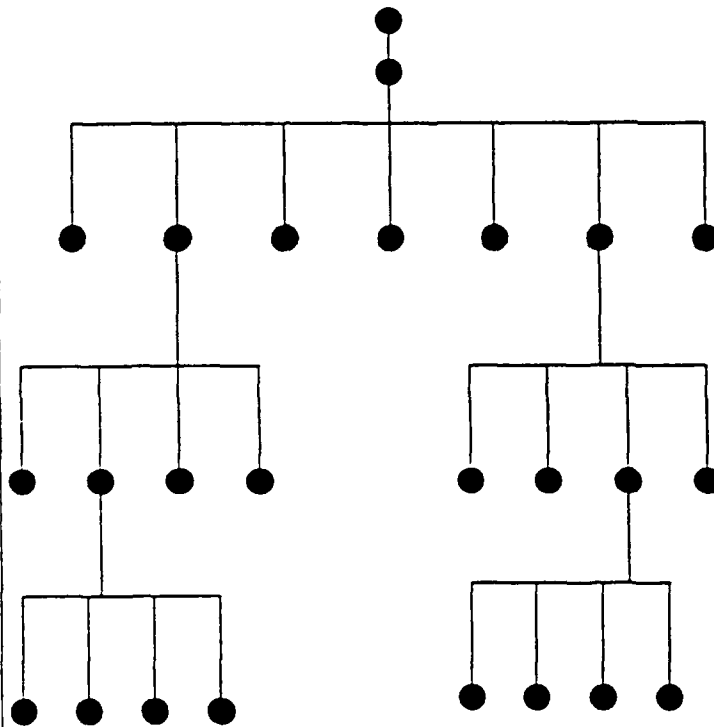
II. Management By Results

American managers, for the most part, are a tough lot who have accomplished much. They have helped build the strongest economy the world has known. And yet they are losing control. They have not used the full potential of their organizations. They have failed in many respects to satisfy their customers. And so they are losing them.

Most American managers manage, at least in part, by Management by Results. In this style of management, the emphasis is on the organizational chart and the key control points within that

structure (Figure 1). Each manager, beginning at the top, is given certain goals for the next year. They, in turn, set goals and impose controls on each of their subordinates. A CEO, for example, may be given simply a profit objective. He or she will then typically give each division head a profit objective. A division head then has to set goals or quotas for each department head. In a manufacturing organization, for example, the sales department may be told to increase sales by 10%, production to increase productivity by 5%, engineering to get products into production 10% faster, purchasing to reduce costs by 5%, quality to decrease warranty costs by 20%, and so on. At the lower levels, these goals become quotas or work standards.

Figure 1: Management By Results



The classic organization was invented 150 years ago, born of the separation and decentralization of functions. The chart also depicts the downward path of control that operates under Management by Results. Each person, represented by a dot on the chart, is governed and evaluated through a set of numerical objectives, performance standards or work quotas—the results that his or her manager wants. This network of controls is typically constructed so that the sum of the accomplished objectives at one level will fulfill the objectives of the person immediately above. The apparent logic of this system of control tends to obscure its harmful side effects.

Management by Results is simple, logical and consistent. It seems to have been quite successful. It is practiced by nearly every major American corporation. It is widely taught in business schools. And it is attributed by many for getting us to where we are today.

But there is an underside to Management by Results. Consider these examples:

- An electronics firm typically ships 30% of its production the last day of the month. Why? In order to meet the monthly shipment quota. How? By expediting parts from around the country, by moving partially completed instruments ahead of their place in line, and, occasionally, by letting quality standards slip.
- Another firm sometimes ships incomplete instruments. A service representative then flies around the country installing the missing parts. The shipment quota for the month is met again. Profits, at least on paper, hold firm.
- A chemical plant reports it cannot efficiently run at the mandated inventory levels, so it keeps inventories higher until June 30 and December when inventories are measured. For those days, it depletes the inventories to an acceptable level, perhaps losing two days production as a consequence.
- Many managers annually negotiate safe goals and manage to exceed them, just barely. Some managers include on their list of negotiable goals, which were already secretly accomplished prior to the negotiation.
- Production which exceeds the standards is stored so it can be pulled out and used another day.
- A meter reader stops at a tavern at 2:00 rather than exceed his work standard.
- Problems are hidden from management, in hopes they will blow over or not be noticed.

These are just a few of examples of problems that occur with Management by Results. It has many shortcomings. Most occur because the larger

purpose and greater good of the work being done gets displaced by the controls themselves. The workers, supervisors and the managers get caught up in organizational pretense where looking good overshadows doing well.

Here are but a few of the many negative aspects of Management by Results:

- It is a system of controls. The rewarded accomplishments are therefore necessarily measurable and short term. The near horizon gets attention and countable accomplishments get priority even though an organization's survival may depend on the unmeasurable activities undertaken to accomplish long term results.
- Systems of controls without a long-term, larger purpose will always set up conflict in an organization. The controls which direct one unit's short-term gain will contradict the controls which direct the short-term gains of another unit. Sales will make promises which production can't keep. Engineers will rush products into production before they are ready. Purchasing will buy materials which the warehouse can't store and the people on the line can't use. Planners and policy-makers plan programs which service personnel aren't equipped to provide. Each group struggles to conform to its controls independently of other groups and sometimes at their expense.
- When measurable controls are unattainable or impractical, individuals and groups tend to fabricate conformance. They "play the game" because not to do so would risk looking bad. The twice-per-year depletion of inventories is a movie-set approach to conformance. Behind the appearance, there is no substance. But it looks like controls are in effect.
- This charade of conformance fosters guarded communications, minor—and even major—dishonesty. The greater the stress on reaching unattainable goals, especially when someone's career is on the line, the more likely it is that the figures will be juggled.
- The inevitable contradictions between the controls of different departments leads to finger pointing, blame games and an endless series of excuses—like "if it weren't for them . . ."
- Related to the blame-it-on-them mentality is a cover-your-rear mentality: play it safe, don't trust anyone and make sure that when the system breaks down, someone else is at the switch. In times of stress, circle the wagons. Don't help others, especially if they're under fire.
- Behind the worst shortcomings of Management by Results is fear. Fear is the prime motivator in a Management by Results system. And the more rigid and unrealistic the controls are, the deeper is the fear.
- Management by Results encourages an organization to look inward at its own structures rather than outward at the world in which the customer operates. Rather than delight in providing a product or service that works and satisfies the customer, the sense of accomplishment comes from meeting the controls. It becomes a self reinforcing cycle. A manager or supervisor has a goal imposed on him or her. The manager works to meet that measure, however much distortion might occur at some other time or place in the organization. Meeting the short term measurable goal is an indicator of the success of the individual and the success of the system of controls. Thus, there is fostered a Titanic-like complaisance about the invulnerability of the operation. When there finally is some awareness that the indicators of control may be focused on the wrong measurements, it's too late. The ship is going down and "Nearer My God to Thee" is heard from the afterdeck.

It is interesting to note that Management by Results is widely used in the Soviet Union. Typical is this story: Several years ago there was a surplus of large nails and a shortage of small ones. Why? Managers were held accountable for the tons of nails produced. Later the control was changed to the number of nails produced. This led to a shortage of large nails, since smaller nails gave higher counts.

III. Total Quality Leadership

Managers often say, "I agree, there are serious problems with Management by Results, but what is a better alternative?"

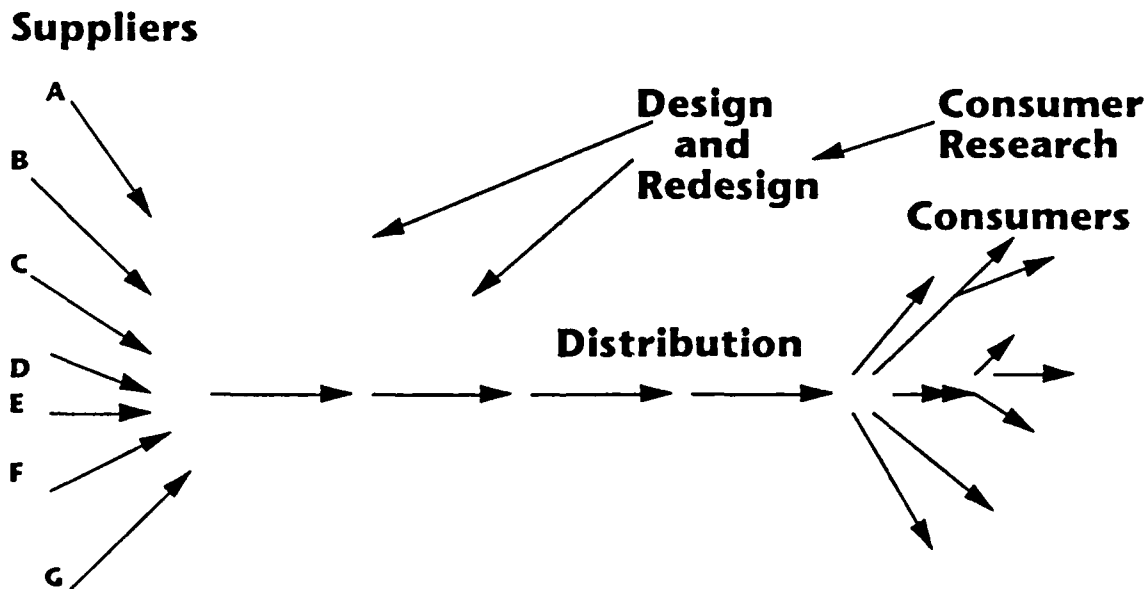
The alternative, we believe, is Total Quality Leadership.

Simply put, Total Quality Leadership is an approach to management which focuses on giving top value to customers by building excellence into every aspect of the organization. This is done by creating an environment which allows and encourages everyone to contribute to the organization and by developing the skills which enable them to scientifically study and constantly improve every process by which work is accomplished.

In all organizations there are processes by which things get done. There are processes of production, of sales and of distribution. There are also processes to find out about customer needs and problems. There are processes that couple market information with information on new technologies. These in turn generate ideas for new products and services. Other processes create and test these new products and services and move them into routine production. Still other processes study costs and value added throughout the organization. There are literally thousands and thousands of processes, the overall health of which determines the future of the enterprise.

In Total Quality Leadership the emphasis is on studying these processes (Figure 2) and on executing them better and better to provide customers with products and services of ever increasing value at ever lower costs.

Figure 2: The Structure Important to Total Quality Leadership



Rather than focus on a hierarchy of individual accountability, the Deming Way focuses on the processes by which the work gets done. It has different internal logic: each internal process must work well and interact well with the processes that precede and follow it. Together, all the processes must result in products or services that meet or exceed the customer's expectations. Continuous communication with customers provides the feedback needed to improve the organization's products and services, and the processes by which work gets done. Imposed goals, quotas, and exhortations are recognized as generally harmful. As Dr. Deming says, "a goal that lies beyond the capability of the system cannot be achieved except at the destruction of the other systems in the company." Employees are viewed not as points out of control, but as willing collaborators in an ongoing effort to improve every aspect of the organization's work.

The focus in Total Quality Leadership is on **QUALITY**—the quality of every product and service and the quality of every process—this emphasis on quality is shown at the apex of the triangle in Figure 3.

To achieve this higher quality, every process, beginning with the most important, is studied using the **SCIENTIFIC APPROACH**. Processes are described with flow charts, problems are identified, the root causes of problems are determined through careful research and new fool-proofed systems are developed. Every process is brought under statistical control and variations are further reduced, well beyond specifications.

The use of the Scientific Approach, as shown at the bottom left of the triangle in Figure 3, becomes pervasive.

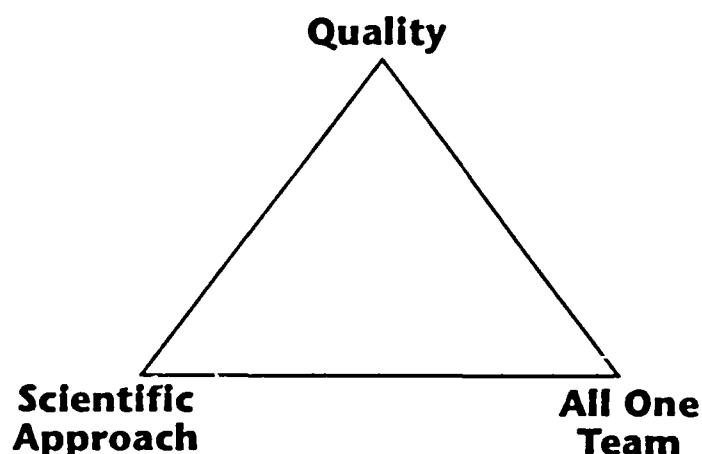
In many cases, the most difficult aspect of Total Quality Leadership is to create an environment of **ALL ONE TEAM**. If a company is to be truly excellent in every activity, everyone throughout the organization must work together to improve processes and to execute them with energy and efficiency. It requires a fundamentally different view of the relationship between employees and the organization. In order for all employees to be committed to the organization, the organization must be committed to its employees. This environment of total teamwork cannot be developed under Management by Results.

Total Quality Leadership is not widely practiced in the United States, but it is not new, nor is it foreign. Its roots go back to the early 1900s and its principal prophet is a Sioux City, Iowa, native named W. Edwards Deming. A statistician by training, Deming formed many of his theories during World War II when he taught industries how to use statistical controls to improve the quality of production.

But when the war ended, American industry turned its attention to meeting the huge demand for consumer goods, without the pressure for efficiency or quality that guided it through the war years. And for almost 20 years there was no foreign competition.

Across the Pacific, however—where “Made in Japan” meant junk—there were people willing

Figure 3: The Joiner Triangle



The three fundamental elements of Total Quality Leadership begin with a focus on Quality—that is, a focus on customers. Use the Scientific Approach to study and improve all of the organization's processes. And treat everyone as “All One Team”: break down barriers and drive fear so that everyone can work for the company.

to listen. Deming told them to find out what their customers wanted, then to study and to improve their product design and production techniques until the quality of the product was unsurpassed. He taught them the product was “still in the development process when it was in the customer's hands.”

His influence began with a dinner meeting in 1950 organized by the Japanese Union of Scientists and Engineers with 45 leading industrialists at industry club in Tokyo.

He has since recalled that meeting. We will quote his recollections extensively since they are so central to his thesis:

“They thought they could not (compete) because they had such a terrible reputation for quality . . . I told them, ‘You can produce quality. You have a method for doing it. You’ve learned what quality is. You must carry out consumer research, look toward the future and produce goods that will have a market years from now and still stay in business . . .’

“Incoming materials were terrible, off gauge and off-color, nothing right. I urged

them to work with the vendors and to work on instrumentation. A lot of what I urged came naturally to the Japanese, though they were not doing it. I said, 'You don't need to receive the junk comes in. You can never produce quality with that stuff. But with process controls that your engineers are learning about—consumer research, redesign of products—you can. Don't just make it and try to sell it. But redesign it and then again bring the process under control . . . with an ever-increasing quality.'

"I told them they would capture markets the world over within five years. They beat that prediction. Within four years, buyers all over the world were screaming for Japanese products."

The rest, as they say, is history.

IV. Key Components of Total Quality Leadership

Here are some of the key components of Total Quality Leadership:

- It recognizes—as Dr. Joseph Juran has argued since the early 1950s—that at least 85 percent of the failures in any organization are the fault of systems controlled by management. Fewer than 15 percent of the problems are actually worker related. In Total Quality Leadership, the focus is on constantly and rigorously improving every system.
- It asserts that work is not haphazard. It can be and must be studied, analyzed and scientifically dissected.
- It insists that processes must be standardized and that standardized procedures must be followed. Variation must be reduced in output and in the way things are done, yet the opportunity must be provided for everyone to contribute to improving the processes and to eliminating problems.
- It has a customer focus, an obsession with quality.
- It recognizes that there are both external customers and internal customers—other employees who depend on your work to be able to perform their jobs properly.
- It demands improved relations with suppliers, a true working partnership, which in most cases will require a single supplier for each item.
- It emphasizes process improvement rather than individual accountability.
- It requires that communication systems be adapted to the needs of the work, not to the needs of the hierarchy.
- It demands constancy of purpose throughout the organization, persistence in accord with a clear and widely understood vision. It is an environment which nurtures total commitment from all employees. Rewards go beyond simple benefits and salary to the belief "we are family" and "we do good work."

Total Quality Leadership is a management philosophy that starts with the customer, not with the bottom line profit and loss statement.

It is very data oriented and calls for monitoring thousands of variables inside and outside the organization. These numerical measures are used to guide the search for better performance, and are recognized as means rather than ends, as guides to deeper truths, rather than items to be controlled.

In Total Quality Leadership there is freedom, yet there is control. There is the freedom to discover new markets, to develop new systems, to gain greater mastery over the processes. And there is the control of a data based approach to improvement.

Many managers have great trouble understanding why they should focus on improving the systems that serve the customer rather than simply on profits. The Deming Chain Reaction in Figure 4 may help.

When quality is increased by improving processes (not by expanded inspection), the better quality will lead to better productivity, which

will lead to lower costs. Better quality and lower prices mean the company can expand its market, and can stay in business creating jobs and a greater return on investment.

Management by Results, on the other hand, tends to focus only on the end result—the return on investment; it is like wagging the tail to keep a dog healthy.

It is a tough concept to comprehend and it takes a leap of faith to make the fundamental shift from Management by Results to Total Quality Leadership. There is no easy way to make the change. It seems best to us to use a gradual process of letting go from the old style while embracing the new.

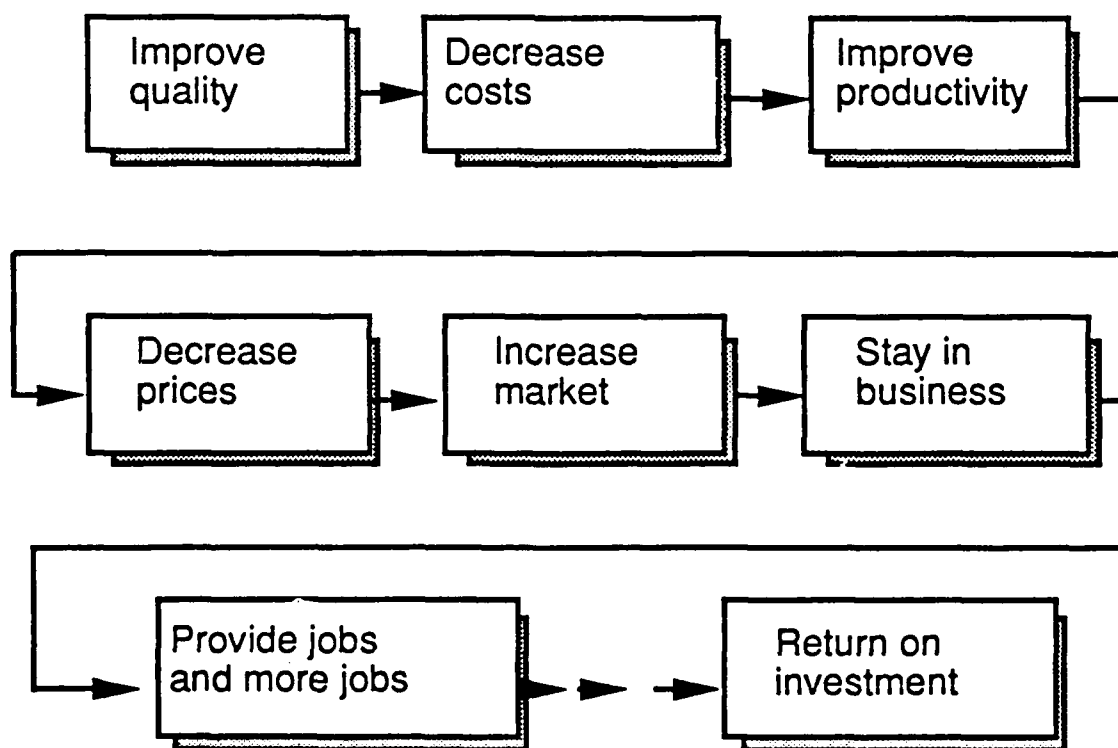
Working in collaboration with a number of people, and receiving considerable advice and counsel from Dr. Deming, we have developed a general

model for implementation. Our model is not static as we continue to learn by working with a variety of organizations seeking to make the transformation.

Key elements of this model include:

- The education and re-education of managers. They must become leaders instead of bosses, coaches instead of enforcers. They must focus on solving problems and constant improvement instead of blaming and controlling. The quality-focused approach to leadership requires continuous feedback from the customer, and constant communications and feedback within and between units of the organization.
- The development and communication of a clear vision of the organization's future. It is a vision which says: here is what we

Figure 4: The Deming Chain Reaction



When you improve quality by improving processes—not by increased inspection—the result is decreased costs. Lower costs means better productivity. Better quality and lower prices mean increased market and the ability to stay in business and provide jobs and more jobs. All this put together gives shareholders a solid return on their investment. (The last element, "Return on investment," has been added by the authors.)

are, here is what we do, here is where we're heading and here is what is important and unique about us.

- The formation and development of true management teams. They are essential for leading the company in its normal business functions and for leading the implementation of Deming's approaches so that Total Quality Leadership itself becomes a "normal business function." Teams are essential for maintaining "constancy of purpose," for "breaking down barriers" between departments, and for "driving out fear" among the managers themselves.
- Targeted implementation efforts and an overall strategy. A common mistake is for companies to try to involve too many people too soon in the improvement efforts. It is easy to plant a big garden, but very hard to tend it, harvest it, and make good use of the crops. Don't begin more improvement efforts than you can realistically support and maintain.
- Management-selected projects and project teams using the scientific approach to improve processes. Usually the teams consist of a mixture of professional staff, managers, supervisors, and hourly employees who use scientific methods to study and improve processes.
- Developing or recruiting key resources, including a senior statistician, a senior organization development specialist, and intermediate level resources who are trained in both statistics and organizational development to coach project teams. They play a special role in the transformation by providing help with the scientific investigation of processes and with facilitating the dramatic changes in the organization, its management and its culture.
- Leadership, participation and oversight by managers, beginning at the top. This is an absolute essential. The most frequent cause of failure of any quality improvement effort is the non-involvement or indifference of top and middle management. Passive support is not enough. Total Quality Leadership must involve everyone.

- Developing champions who will help the transformation succeed even during rough periods.

V. How to Get Started

For managers who want to contribute to the transformation to Total Quality Leadership, there is much to learn.

If you haven't already done so, we suggest you read the books of Deming, Juran, Ishikawa and the papers by Tribus and Fuller listed below. Attend the four-day seminars by Deming and Juran. Visit Japanese managed companies here and abroad. Expand your knowledge of statistics and organization development.

Remember, the best way to get others to change is for you yourself to change. Begin with your own work. What can you do to improve the quality of your work and the satisfaction of your "customers?" Listen to your "customers" and to those with whom you work. In whatever decisions you make in your job, begin replacing educated guesswork with reliable data. Strive to eliminate blaming and replace it with problem-solving.

Begin to practice the new approach with others in your department. Work with people to break down barriers and drive out fear. Help them study and improve the systems in which they work. Help them document the best known practices and provide effective supervision so they are conscientiously followed. Then help everyone continue to work and develop still better systems.

Deepen your understanding of Management by Results and come to recognize its limitations. Learn to see it in all its different guises.

Look at your own company. What are the forces that make things work? What dominates your daily work life—fear, or turf battles and constant pressure to meet quotas? Or is there cooperation and planning based on specific facts? Do you feel like a cog in the wheel or like an integral and

important part of the process? Does the bottom line rule all? Or are the customer and quality of work the recognized goals of your company?

When you've done all this, you'll be in a better position to come up with some creative ways to think about how to help your organization move from Management by Results to the new way—Total Quality Leadership.

VI. Acknowledgments

We are indebted to many people for the development of the ideas expressed in this paper. Chief among these are Dr. W. Edwards Deming, Warren Gaskill, Laurel W. Joiner, Mary Ann Gould, F. Timothy Fuller, Myron Tribus, Harry V. Roberts, R.D. Snee, Thomas J. Boardman, Conrad A. Fung, William C. Crane, and Eric Dmytrow.

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Juran, Joseph M. *Managerial Breakthrough*. New York: McGraw Hill. 1964.

Tribus, Myron. Author of a series of excellent papers on Deming, quality and management which are available upon request from The Center for Advanced Engineering Study, Massachusetts Institute of Technology, Room 9-213, 105 Massachusetts Avenue, Cambridge, MA 02139. We recommend in particular: "Deming's Redefinition of Management," "Productivity. . . Who is Responsible for Improving It?" "Managing to Survive in a Competitive World," and "The Quality Imperative in the New Economic Era."

SECTION IV: LEADERSHIP FOR IMPROVEMENT OF ORGANIZATIONAL QUALITY

Ohio Quality and Productivity Forum. (1989). Commentaries on Deming's Fourteen Points for Management: Deming's Point Seven: "Adopt and institute leadership." Available from Ohio Quality and Productivity Forum, 1973 Edison Drive, Piqua, OH 45356.

Baker, E. M. (April 19-21, 1989). The chief executive officer's role in total quality: Preparing the enterprise for leadership in the new economic age. Paper presented at the Dr. William G. Hunter Conference on Quality, Madison, WI.

Loubert, S. (1988). Process management: The new role of managers. Available from Process Management Institute, Inc., One Paramount Plaza, Suite 360, 7801 East Bush Lake Road, Bloomington, MN 55435-3830.

Baker, E. M. (November 1987). The quality professional's role in the new economic age. Quality Progress, 20(11), 20-28.

Successful implementation of organizational change requires that management take a leadership role in creating a climate that supports and encourages participation in the organizational improvement and change effort. This set of papers describes management's leadership role in the improvement effort at several levels of the organization.

Ohio Quality and Productivity Forum. (1989). Commentaries on Deming's Fourteen Points of Management: Deming's Point Seven: "Adopt and institute leadership." Available from Ohio Quality and Productivity Forum, 1973 Edison Drive, Piqua, OH 45356.

The Ohio Quality and Productivity Forum is comprised of members of several companies that meet periodically to deepen their understanding of the quality philosophy, management tools, and other issues of concern to them. One product of their study is a helpful and very readable series of commentaries on various topics related to organizational quality.

Their discussion of Deming's Point 7, "Adopt and institute leadership," is an example of their collaborative effort. The topics discussed include why the quality philosophy requires an enlarged view of leadership, the vital role of leadership in achievement of improvement of quality, productivity, and organizational transformation, the newly defined relationship between employees and their managers, customers and suppliers, the new responsibilities of supervisors, leaders, and managers, as well as implementation issues.

An appendix describes several key concepts which underlie the transformation process: continuous improvement, removal of barriers that prevent people from taking pride in their work, recognition of interacting forces within a system, an understanding of variation, the importance of managing causes rather than results, tampering, global optimization, the customer-supplier relationship, and a redefinition of quality.

Commentaries on Deming's Fourteen Points for Management

This monograph is one in a planned series of studies on each of Deming's Fourteen Points for Management. What follows is a summary of the study and discussions of Deming's **Point Seven** by the Ohio Quality and Productivity Forum (OQPF) Roundtable.

Begun in October, 1986, the Roundtable is sponsored by OQPF, a "Deming users' group" operating in southwest Ohio. The Roundtable is a coalition of teams from six Dayton-area companies which meets bi-monthly under the guidance of Dr. Gipsie Ranney of the University of Tennessee. The two-day work sessions are intended to develop and expand the knowledge company teams need to implement and sustain the organizational change required to continuously improve quality and competitive position in their respective companies. The mission statement for the Roundtable explains:

We are building a deeper understanding of the Deming Philosophy in order to enhance our effectiveness as change agents in putting Deming's principles into practice.

Our success will be measured by our ability to:

- create a vision of how our companies ought to be operating
- develop a strategy to fulfill that vision
- educate and train ourselves and others in the philosophy, process, tools and techniques in order to effect the transition
- guide our action along the path of continuous improvement.

This document contains contributions from the individuals who participate as members of the Roundtable. It represents our thinking at one stage along the path we are taking in fulfilling our mission and is offered as a contribution to the existing body of knowledge rather than a definitive statement on the subject. The final draft and editing was done through the collaboration of Dr. Gipsie Ranney of the University of Tennessee and Ben Carlson of Vernay Laboratories.

PARTICIPATING COMPANIES

EG & G Mound Applied Technologies - Miamisburg, Ohio
Marco Molding - Dayton, Ohio
Master Industries - Ansonia, Ohio
Navistar International - Chatham, Ont., Indianapolis, Ind., Columbus and Springfield, Ohio
P.Q. Systems - Dayton, Ohio
Vernay Laboratories - Yellow Springs, Ohio

The participating members acknowledge with appreciation the contribution of Dr. Gipsie Ranney to our understanding of the Deming Philosophy and to this summary.

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DEMING'S POINT SEVEN:

"Adopt and Institute Leadership."

"The job of management is not supervision, but leadership . . . The required transformation of Western style of management requires that managers be leaders . . . Focus on outcome (management by numbers, MBO, work standards, meet specifications, zero defects, appraisal of performance) must be abolished, leadership put in place."

(-W. E. Deming, *Out of the Crisis* Page 54)

" . . . the most important figures for management are unknown and unknowable (Dr. Lloyd S. Nelson). Variation is a product of any system. Variation may be stable, or it may be afflicted with special causes. As Dr. Nelson says, management's job is to study variation, with the proper theory, to unravel the message that the variation is trying to tell us about how to improve the process--get rid of any important special cause, and to shrink the variation in the future."

(-W. E. Deming, *personal correspondence to OQPF, Dec., 1988*)

"The aim of leadership should be to improve the performance of man and machine, to improve quality, to increase output and simultaneously to bring pride of workmanship to people. Put in a negative way, the aim of leadership is not to find and record failures of men, but to remove the causes of failure: to help people do a better job with less effort."

(-W. E. Deming, *Out of the Crisis, Page 248*)

AN ENLARGED VIEW OF LEADERSHIP

Much of what has been written in the past about the subject of

leadership has examined the leader's personal qualities and characteristics which create the willingness to follow in those persons being led. Terms like trustworthy, courageous, compassionate, visionary, persuasive, and charismatic are often used to describe the observable personal behavior associated with leadership (The reader may wish to refer to books on leadership noted in Appendix II). Deming's writings about Point Seven do not dismiss such qualities, but represent an expanded view which extends beyond behavioral characteristics to thinking and practice.

The purpose of this monograph is to examine the practice of Leadership in light of what we understand of Deming's writings and comments on the subject.

In any organization where people have had jobs of "supervising" or "managing" others, Dr. Deming says the traditional activities associated with these jobs should be replaced by "Leadership." Traditional supervisory activities include auditing and inspection of the performance of others. Such activities are reactive rather than proactive. Deming gives very specific examples of what Leadership means with emphasis on organizational management. He comments on what a Leader will know, will do, and what beliefs and assumptions the Leader will operate under to do his/her job in accordance with the Fourteen Points.

It has been noted that Dr. Deming has modified Point Seven several times as his own thinking and understanding have evolved. In the National Productivity Review (Winter, 1981/82), he urged us to "Improve Supervision." Later in 1982, he concluded in his first book

that supervision as he perceived it did not yet exist and changed the wording to "Institute Supervision" or "Institute Modern Methods of Supervision". (-W. E. Deming, **Quality, Productivity and Competitive Position**) James Fitzpatrick of General Motors is credited by Dr. Deming as having suggested the term Leadership in place of supervision. (-Scherkenbach, **The Deming Route to Quality and Productivity**)

WHY IMPLEMENT POINT SEVEN ?

Adopting the Deming methods of management which differ from those traditionally practiced in the United States is critical to the successful implementation of the other thirteen points. As Deming points out " . . . most of this book (*Out of the Crisis*) is involved with leadership." The vast majority of an organization's problems (the estimate was recently revised upward from 85% by Dr. Deming) are the result of shortcomings and flaws in processes and the system as a whole. Responsibility for these is clearly in the hands of management. Understanding **why** those shortcomings and flaws create problems will come only from a thorough understanding of variation and the actions needed to eliminate the causes of variation.

Failure to practice the new methods of management will continue to produce, or will result, in most of the following kinds of consequences:

- * employees submersed in dealing with each day's crisis or quota,
- * improvement efforts stalled by focusing on conformance rather than improvement,
- * people unable to achieve their potential,
- * employees blamed for problems that are actually faults of the system,
- * employees asked to explain variation which results from causes which are common to all outcomes and can only be removed by management action to change the way the system operates,
- * "program-of-the-month" management (lack of constancy of purpose) resulting in employee cynicism,
- * employees frustrated and demoralized by being prevented from doing high quality work and being powerless to change the system,
- * adversarial relationships with customers, suppliers and employees,
- * the cost of products and services bloated by waste,
- * product of unpredictable quality,
- * dissatisfied customers,
- * stagnant or eroding market position.

TO WHOM IS POINT SEVEN DIRECTED?

It is logical that leadership should start at the top of any organization but it is also clear that it is not limited to top management. In most instances, there will be at least three levels to which the principles of leadership apply:

1. Top management must provide constancy of purpose for the organization . . . the drive toward continuous improvement and innovation of products and services. This is necessary for the long term survival of the the organization. Top management must act with an understanding of variation, cause and effect and Total Cost. As Deming has observed, it is also top management's responsibility to create the system and to provide both the resources and a plan to carry out its mission. And, by example of their actions, top management must lead the organization in fulfilling that mission.
2. Departmental and mid-level managers need also to lead, by example, their respective functions with the same understanding of variation and its effects. Their focus will be on improving the processes of the organization and helping top management break down intracompany barriers. Like top management, they too, must lead in accord with the Fourteen Points.
3. First-level supervisors must learn to shed their traditional role and to adopt the principles of leadership discussed

by Dr. Deming. Their new role is primarily one of helping their employees do a better job by providing good tools, materials, equipment, training, instructions and other resources necessary to produce a quality product. "A supervisor must be more than a judge or overseer as the name implies. In this new economic age, he must be a coach and a teacher." (-W. W. Scherkenbach, **The Deming Route to Quality and Productivity**, Chapter 10)

SOME DEMING COMMENTS ON LEADERSHIP

What Dr. Deming focuses on is not the personal qualities typically associated with leadership, but the deeds, the thinking and the knowledge that distinguish his leader from the typical manager or supervisor.

In his earlier book, in reference to "modern methods of supervision" he notes three points about first-line supervisors' role in helping their employees:

1. Supervisors should "remove barriers that make it impossible for the hourly worker to do his job with pride of workmanship."
2. Supervisors "must be empowered and directed to inform upper management concerning conditions that need correction (inherited defects, machines not maintained, poor tools, fuzzy definitions of acceptable workmanship, emphasis on

numbers, not on quality). Management must take action on corrections so indicated."

3. "Most acts of supervision in management and on the floor of the factory and of the department store, instead of providing help to people accomplish just the opposite. [This] book abounds with examples."
(-W. E. Deming, **Quality, Productivity and Competitive Position**)

One of Deming's key points is that most differences in observed performance in work settings are likely to be due to variation produced by the system in which the workers operate rather than due to actual differences caused by the workers themselves. It is important to be able to distinguish which is which. In **Out of the Crisis** he states: "Specifically, a leader must learn by calculation wherever meaning figures are at hand, or by judgment otherwise, who, if any of his people lie outside the system on one side or the other, and hence are in need either of individual help or deserve recognition in some form."

In the same section of **Out of the Crisis** (Chapter 8) Deming comments further on the new leadership role of the supervisor or manager: "The leader also has responsibility to improve the system - i.e., to make it possible on a continuing basis, for everybody to do a better job with greater satisfaction" . . . and . . . "to accomplish ever greater and greater consistency of performance within the system, so that apparent differences between people continually diminish."

It is common practice for many supervisors and managers to pay a great deal of attention to reports and data which tell them what happened

yesterday, last week, last month, or last year. Often such reports highlight the things that have gone wrong. Dr. Deming has compared this to attempting to drive a car by looking only in the rear-view mirror. Because of this, in his 4-day seminars he observes that "A supervisor is an auditor of failure, while a leader listens and learns studies and understands and works to improve the system."

He also notes that "One important characteristic of a leader is that he will forgive a mistake - there will be mistakes."

THE LEADER'S RELATIONSHIP WITH THE EMPLOYEES

Over and over, Deming emphasizes an important point: "A good leader will help people understand what their job is." This recurring theme is worth some attention. First, it is essential to note that the signals a person receives about what he/she is supposed to do can change **daily** depending on what the supervisor needs in order to achieve today's required results . . . unless there is constancy of purpose. Without consistent priorities and clear direction, the employee may be trying to hit a moving target. The "boss" should not see him/herself as the customer the employee is trying to please, but rather the **supplier** of resources and guidance to the employee in order to help the employee meet the needs of the **organization**.

By definition, a manager or supervisor has at least one person for whom he has "supervisory" responsibilities. Here are some questions he/she might ask:

- Do I know what this person must do in order to carry out his/her job?
- Have I discussed this with him/her so that there is a common understanding of what he/she needs to do?
- Have I provided him/her the necessary resources to do this job? (tools, training, time, equipment, information, good materials, etc.)
- What does this person see as the barriers to doing this job well? (What robs him/her of pride of workmanship?) What have I done to remove those barriers?
- Have I asked what this person needs from **me** to do this job?
- Do I know what his/her needs are as an individual?
- Am I acting as a coach and teacher . . . or am I simply grading past "performance"?
- Have I provided opportunities for in-depth discussions with this person about this job and its objectives? Instead of an appraisal, "Hold a long interview with [each of your] employees . . . three or four hours at least once a year, not for criticism, but for help and better understanding on the part of everybody."
(-W. E. Deming, **Out of the Crisis**)

The leader must also have a good understanding of the **context** for each job. For example, it would be important to know at least the following:

What are the products (results which go on to another stage) from this job?

Who are the users (customers) of the results of this job?

What do the customers need in order to best use the results of this job?

What resources must the employee have to meet those needs?

What are some of the penalties for failure to do this job?

Who supplies the inputs to this job? Are the inputs suitable for use?

In addition, the leader must have an understanding of the skills, abilities and behavior needed to successfully perform this job. If the leader has not personally performed the work him/herself, then time should be allotted to study and learn about the job.

Unfortunately, it is common for organizations to move managers from one assignment to another, resulting in too little time to learn his/her job or gain the necessary knowledge of the jobs of those he/she supervises.

Such movement of managers may also have other implications which could affect the organization's objectives. Changes in supervisors or managers may add a significant source of variation to a process in ways that are not recognized by the organization. For example, differing views of the relative importance of various activities by successive managers may be perceived by employees as lack of constancy of purpose.

In addition, changes in supervisors or managers every year or two may cause employees to be wary of change or "improvement" that results from each supervisor's desire to make his or her own "mark" before moving on. This may create resistance to any and all improvement efforts.

NEW LEADERSHIP ACTIONS

The following contrast actions of the traditional supervisor with those of a Leader:

SUPERVISOR

Attempts to control results.

Acts as judge or overseer.

Primary job is "fire fighting" (problem solving).

Holds people accountable for results without providing methods for improvement.

Calls defects to peoples' attention and assigns cause to each.

Identifies who is above or below average; attempts to make all performance above average.

Attempts to ascribe all performance to the individual and ranks employees accordingly.

Identifies which employees are not motivated or committed and works to remove them.

Works on handling "more and faster".

LEADER

Studies the system of causes and acts on causes.

Doesn't judge people on results which are combined effects of the interaction of the system and the people.

Primary job is to improve processes and prevent problems.

Studies processes in order to remove or reduce barriers which prevent people from doing (and taking pride in) quality work. Identifies people who are in need of special help.

Works with employees to improve the process. Is empowered to inform management of conditions that need correction.

Understands that roughly half of any set of results will be below the average result. Knows that all performance cannot be better than the average.

Recognizes that performance is the result of the **combination** of individual effort, effect of the larger system and the interaction of the two.

Identifies performance which is exceptional (rare, outside the system). Works with those whose performance is exceptionally poor. Learns from those whose performance is exceptionally good. Realizes there **may not be any** exceptional performance in his/her group.

Works with his/her people to develop new and better methods for doing the job.

SUPERVISOR

Ignores training and/or allows operator to train operator. (In some cases this may be de facto organizational policy.)

Sees employees as a commodity with limited potential for improving.

Attempts to control absenteeism.

Often chooses to take no action because that requires no explanation and no risk.

Has a passive "I'm behind you all the way" mentality which leaves responsibility for risks unclear.

LEADER

Maintains primary responsibility for seeing that his/her employees are trained. Makes use of a training process which ensures consistency of training for all operators.

Knows employees are a valuable resource, worth investing in.

Understands the difference between common cause and special cause absenteeism and helps people feel needed so they want to come to work.

If his/her manager understands mistakes will occur, takes a reasonable risk or experiments for the purpose of improvement.

Has an active "Follow me" mentality showing he/she accepts the responsibility for risks.

occur wherever courses in management or supervision are taught . . . in the universities, within the company, and in any appropriate seminar or workshop. The ideas and concepts of Deming that are reviewed in this monograph would be a good start for such education.]

2. **More careful selection of the people in the first place.** [Here we assume Deming speaks of "careful selection" of all employees at the time of hiring as well as selection for supervision or management. Understanding common and special cause variation as well as the new role of Leadership will help to make the selection process more effective.]
3. **Better training and education after selection.** [Deming comments in books and seminars on the content and on the methodology of training. He observes that worker training worker can be disastrous unless the trainer is trained and the training plan provides for training which is consistent in content and method. Employees at all levels must understand the effects and causes of variation in a process. For supervisors and managers, the ideas and concepts outlined in Appendix I of this paper will be important to know.]
4. **A leader, instead of being a judge, will be a colleague, counselling and leading his people on a day-to-day basis, learning from them and with them.** [While such a statement may sound idealistic to some, the reasoning for such a relationship with employees is derived from an understanding of the world as it is, not how managers have

IMPLEMENTING POINT SEVEN

"What will make for quality products and services as well as renewed leadership in the 1990's? The prime requisite for achievement of any aim, including quality, is joy in work. This will require change, and management's job is to accomplish this change.

My own estimate is that today only two in 100 people in management take joy in their work. The other 98 are under stress, not from work or overwork, but from non-productive work - churning money, battling for or against takeover and so on. Most of the 98 have their eyes

on a good rating and don't dare contribute innovation to their work."
-W. E. Deming, **VISTA** (magazine)

Where does one start, then, to make all this happen? What does it take to "adopt and institute leadership"? How does top management provide the organization with the necessary leadership? Instituting Leadership requires replacing much of what passes as management today with something better.

Deming's suggestions for implementation include (**Out of the Crisis**, pp. 116/118):

1. **Institute education in leadership; obligations, principles and methods.** [Such education should

wanted it to be in the past. It comes from recognizing that achieving results by imposing authority will limit or even prevent improvement and may lead to active or passive resistance. Enlightened management knows this and appreciates the effectiveness of good leadership.]

5. **A Leader will discover who if any of his people is (a) outside the system on the good side, (b) outside on the poor side, (c) belonging to the system.**

["The calculations required are fairly simple if numbers are used for measures of performance. Ranking of people (outstanding down to unsatisfactory) that belong to the system violates scientific logic and is ruinous as a policy . . . People on the poor side of the system will require individual help."]

6. **The people of a group that form a system will all be subject to the company's formula for raises in pay.** ["This formula may involve seniority. It will not depend on rank within the group, as the people within the system will not be ranked No. 1, No. 2, (etc.). (In bad times, there may be no raise for anybody.)"]

7. **Hold a long interview with every employee, three or four hours, at least once a year, not for criticism, but for help and better understanding on the part of everybody.** [This does not substitute for daily or frequent communication about the job.]

8. **Figures on performance should be used not to rank the people in a group that fall within the system, but to assist the leader to accomplish improvement of the system.** ["These figures may also

point out to him some of his own weaknesses . . . Improvement of the system will help everybody, and will decrease the spread between the figures for the performance of the people."]

In order to begin the implementation of Point Seven, the first step is to start a process of education for managers in the meaning of the Fourteen Points and the Key Concepts described in Appendix I. The education process should begin with Top Management (it would be instructive for managers to address the questions posed by Dr. Deming in Chapter 5 of *Out of the Crisis*). They can then begin to teach others by example and to encourage use of the new principles through their interaction with the next level: asking questions and expecting decision-making analyses which utilize an understanding of variation and Deming's principles. This should not be done, however, without providing

STOP defining quality as conformance to specifications.

STOP managing "results".

STOP purchasing on price tag alone.

STOP "optimizing" the results of individual groups or departments.

for training and education in the theory and methodology needed.

Having said that "The first step in a company will be to provide education in leadership", Deming notes this new leadership serves to replace the old supervisory relationship and in particular, the annual performance review:

" . . . The annual performance review may then be abolished. Leadership will take its place. [Performance reviews] became popular because [they do] not require anyone to face the problems of people. It is easier to rate them; focus on the outcome. What Western industry needs is methods that will improve the outcome."

Other management practices that have come under his criticism are also presented in ways that make it clear that we should not only stop doing them, but we should substitute something better in their place. Examples:

START defining quality as continual reduction of variability about the optimum or target value as defined by the intended use.

START managing and improving the process (causes).

START purchasing on the basis of Total Cost, working with suppliers to reduce variation, and to make improvements.

START emphasizing internal customer-supplier relationships and taking actions which will result in optimizing the whole organization's performance.

— IN SUMMARY . . . —

What is distinctive about Dr. Deming's Leadership is his message that **the job of a leader is to help his people**. Such help depends on:

Knowledge (examples: knowledge of the business, the work, the process, the job. Knowing that the most important figures for management are unknown and unknowable. Knowledge of variation and the statistical methods appropriate for studying variation.) [See Appendix I]

Thinking (examples: understanding variation and the interaction of forces, recognizing "tampering", recognizing that actual and intent may be quite different.)

Actions to change and improve the system (examples: what we choose to work on, how well we do it, how we go about it, practice of the Deming (Shewhart) Cycle, use of statistical theory and methods.)

Leadership is provided, then, by application of the Fourteen Points every day. Transforming an organization to the point where it begins to reap the benefits of this new way of managing is not an overnight task ("there is no instant pudding . . ."). "The problem is where to find good management. It would be a mistake to export [current] American management to a friendly country!" (-W. E. Deming, **Out of the Crisis**, Pg. 6)

Transformational leadership involves a great deal of hard work and will take years to accomplish. But, weigh the increasingly clear risks of continuing to manage as we have been, against the opportunities for competing effectively in the new

global marketplace, and you have a very compelling case for getting started **now**.

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APPENDIX I

— KEY CONCEPTS —

The Fourteen Points are based on understanding that a business enterprise is operated in a time continuum. The results of today were preceded by results in the past and will be followed by results in the future. The job of leadership is to understand the cause system which produced yesterday's and today's results in order to act on that cause system and improve future results. In working to improve the future, it is necessary to understand that variation in results always exists and an understanding of the nature of variation is essential to managing for improvement.

The Fourteen Points are distinct in their individual messages, but inseparable in achieving an understanding of Deming's theory and in implementation. Running throughout this set of management principles, are some key concepts which a Leader must know and understand. The following brief paragraphs are intended only to provide enough information to identify the nature of the concept. Each is worthy of its own study. The concepts are interrelated and are presented, therefore, without an attempt to discuss them in any particular order.

— Long-term thinking —

The actions taken today influence the results of the future. It is important to make decisions and take actions which will not prevent the organization from being able to survive and be economically viable in the future. For example, increasing

short term profits by eliminating investment in training, research, maintenance, and so on, is likely to result in costly consequences at a later time.

— Total cost —

Too often, only the costs which can be captured by existing accounting systems are recognized and taken into account in making business decisions. It is imperative that **all** of the various related and consequential costs associated with a given decision be recognized, even when they may not be easily quantified. For example, the unit cost or purchase price is often the only cost given consideration in making a purchasing decision. In addition to the unit cost, there are costs from downtime, service, warranty, process adjustment to accommodate incoming product variation, and so on, incurred in the use of the product. In some cases these costs cannot be quantified or predicted. The fact that they will be incurred to a greater or lesser degree depending on the selection of the supplier should, however, be taken into account in making the sourcing decision.

— Variation —

Variation exists in results, whether those results are values of a characteristic measured on successive parts produced by a manufacturing process, or values typically used to observe performance of an entire business enterprise over time, such as costs, profits, or production quantities. This variation can be viewed as the result of two kinds of causes, common and special. **Common causes** of variation are part of the system and act on all results; **special causes** of variation do not act on all results, but rather act

sporadically and produce unpredictable results. It is essential to understand the difference between common and special cause in order to take the right kind of action to remove causes, reduce variation and improve results of the future. Deming notes that "the type of action required to reduce special cause variation is totally different from the action required to reduce variation and faults from the system itself . . ."

Action to change the system on the basis of a result influenced by special cause **can** damage the system and add cost. Action to continually adjust the system in response to single common cause outcomes can constitute tampering and worsen future results (increase variation), rather than improve them. The vast majority of variation which exists is due to common cause and therefore due to faults of the system. Since management is responsible for the system, the major portion of the work needed to gain improvement is the responsibility of management. Efforts to reduce variation can result in increased quality and consequently, decreased costs, by removing the waste associated with detecting and correcting problems.

In order to know the difference between common cause results and those influenced by special cause and take appropriate actions for improvement, Dr. Deming notes that it is essential to have a "sound understanding of statistical control." Management by Objective (Management by Results) is an example of failure to understand the concepts of cause and effect, variation and global optimization. Much of the waste imbedded in an organization is the result of attempting to improve results without examining the cause system.

— Continual improvement —

The ability to improve depends on having a significantly different mindset from the popular position of "if it ain't broke, don't fix it."

Reactive efforts to fix problems as they occur result in maintenance of the status quo at best. Continual improvement requires proactive efforts to find means to improve quality and remove the causes of waste on the part of every member of the organization, including the top leadership.

The discipline of continual improvement comes through practice of the Deming (or Shewhart) Cycle: Plan, Do, Check, Act . . . and the use of statistical methods and tools to gain knowledge for improvement. The underlying assumption is that there are always opportunities to improve in an ongoing, incremental fashion. Even small improvements can amount collectively to significant gains in quality and reduction of cost. Continual improvement implies a steady reduction in the number of chronic and incidental problems which must be dealt with on a daily basis and a resulting increase in the resources available for innovation of product and process for the future.

**— Removal of barriers that —
prevent people from taking pride
and joy in their work**

This is a key management principle that is based upon the recognition that best efforts of people at all levels to contribute to the organization are thwarted by barriers put in their way by the larger system. Hourly workers are often provided with faulty materials and equipment, are given arbitrary work standards and quotas and are improperly trained

and coached in their jobs. Many salaried workers are prevented from acting in the best interests of the organization by the need to compete for an annual rating and the need to meet departmental objectives which may not benefit the organization as a whole.

**— Recognition of interacting —
forces within a system**

This concept recognizes that there are many factors which impact on results achieved by the individual, the department and the company as a whole. The influence of each of these factors may vary over time and the factors almost surely interact with one another in their influence on the results. The relationships among these factors are very complex and may be difficult, if not impossible, to analyze. When observing the results achieved by an employee, do we recognize the effect of:

- the quality of the training he/she has received?
- the quality of the information and other resources provided to do the job?
- the quality of leadership provided?
- the complex and multidimensional nature of the job?
- the disruptions that distract him/her?
- the policies and practices that create fear?

All of the preceding are related to the way in which the organization is managed and the employee's performance may be significantly impacted by each of these, but the employee is often held responsible (and blamed) for results which are produced by the combined effect of the individual interacting with the system.

**— Managing causes rather —
than results**

Any process, be it the entire system or a single activity, produces results. At the system level in particular, demanding specific quantitative improvements to certain results can create damage to other results. For example, specifying that costs be reduced by 10% can translate into cutting out activities which can bring long-term improvement of competitive position, such as training, improvement to equipment, research and development, and so on. Another example is the imposition of a 20% across-the-board reduction in the size of the workforce. Such an action can lead to the loss of personnel with critical skills and knowledge, to the detriment of the organization's competitive position. Another example is the reduction of inventory without addressing the causes for its existence. Much inventory exists as insurance for failures; buffer stock to protect against interruptions in production when equipment or quality problems occur. The question which should be asked in these cases is: What are the **causes** of high cost, of inflated staffing levels, of high inventory levels?

Asking questions about cause can lead to more realistic identification of sources of waste and redundancy and allow improvement without unanticipated damage.

Traditional managers have placed a great deal of emphasis on comparing the results of this month to last month, this quarter to last quarter, this year to last year, without recognizing that the history of performance extends beyond the previous time period. Informed study of results requires analyzing the results of this period, last period **and** the periods

which preceded them as the outcomes of a process. When the variation in results over several time periods is analyzed for statistical control, knowledge can be gained for planning and taking appropriate action to improve those factors which will **determine** future results.

— Tampering — (Rules of the Funnel)

Managers who fail to understand special and common cause variation have often incorrectly concluded that the variation observed in results was due entirely to special cause. They have attempted to "adjust" (take action) on the process or system in order to improve the next result by compensating for the deviation of the last result from the desired target or goal. However, when the results observed are influenced only by common cause (the system is stable), such attempts at adjustment will increase variation and make future results worse. These misguided attempts to improve results without an understanding of the nature of variation are called "tampering" by Dr. Deming. Examples of four kinds of such "tampering" are provided in his discussion of the "Rules of the Funnel" in **Out of the Crisis**.

— Global optimization —

Management of results and rewarding performance of individuals or organizational units on those results is often done without consideration of potential damage produced elsewhere in the organization by achieving them. This creates internal competition to achieve local and individual goals and can seriously damage the competitive position of the organization in the marketplace.

Decisions should be made and actions taken at levels which will produce internal cooperation and a search for options and strategies which optimize the position of the **entire** organization. Internal competition will likely produce win-lose results; internal cooperation among individuals and units can produce win-win (all-gain) results for the benefit of the organization. Developing and adopting strategies which produce all-gain results requires not only commitment to and practice of teamwork but elimination of reward systems which promote local optimization and global damage.

— Customer-Supplier — relationships

This concept takes on new meaning within the Deming principles of management. The first is that rather than the usual adversarial relationship created by the economic interests of the two parties, Deming advocates that customer and supplier work **together** to improve quality and reduce costs. A strong case can be made for the benefits to both parties of such an arrangement (see the OQPF Commentary on Deming's Point Four).

The second is a departure from the typical view that a customer is the final purchaser or potential purchaser of the organization's product or service. In the new perspective, each employee also has "internal" customers, the recipients or users of his or her work. In this context, each person is both a supplier and a customer within the organization. Improving the quality of work delivered by each supplier to each customer reduces waste and allows the delivery of a quality product to the marketplace at a competitive price.

— Quality redefined —

"Quality" has often been defined as conformance to specification and most efforts to achieve quality have consisted of producing, and then attempting to screen out, non-conforming product. Little recognition has been given to the waste and cost associated with this approach to achieving quality. Deming enlarges the view of quality to include every activity which takes place in an organization.

The Deming principles emphasize the importance of the customer and supplier working together to develop operational definitions of product characteristics important to the customer. Deming also emphasizes the need for the supplier to innovate in anticipation of the customer's needs. He cites many cases in which suppliers have provided the customer with a product or service without the customer having thought of it. In the marketplace, the organization which delivers value, innovates and provides goods and services which surprise and delight the customer will have the best chance for long-term success.

Baker, E. M. (April 19-21, 1989). The chief executive officer's role in total quality: Preparing the enterprise for leadership in the new economic age. Paper presented at the Dr. William G. Hunter Conference on Quality, Madison, WI.

Baker describes the role of chief executive officers in meeting the competitive challenges faced by American industry. They must provide leadership to create, sustain, and improve organizational capabilities, engender a climate supportive of continuous improvement of organizational process, and nurture the ability and willingness of the work force to contribute to organizational improvement efforts. Baker describes the stages in the evolution of the culture of an organization to one that is supportive of improvement efforts.

Baker also discusses some of the forces that constrain organizational change, principally the models, assumptions, and paradigms entrenched in the minds of leaders, managers, and other members of the organization. Baker makes these strongly held beliefs explicit for his reader, and then suggests new assumptions that might better serve organizations and managerial thinking in today's environment. Among the fundamental assumptions that Baker challenges are:

- the view of individuals as commodities, as interchangeable;*
- The view of an organization as a collection of highly trained and specialized individuals and units linked within a functional hierarchy;*
- The definition of quality as conformance to standards;*
- The notion that customers are outside of the operation of the organization and are solely the domain of marketing and sales;*
- Practices that engender competition within organizations and discourage cooperation and the achievement of synergy;*
- The adversarial relationship between functional chimneys in an organization;*
- The idea that motivation is achieved by aversive control;*
- The use of statistical theory;*
- The notion that most problems in organizations result from actions of individuals rather than from the system in which individuals work;*

--The adversarial relationships between unions and management and between customer and supplier;

--The notion that the job of management is to maintain a stable internal state.

**THE CHIEF EXECUTIVE OFFICER'S ROLE IN TOTAL QUALITY:
PREPARING THE ENTERPRISE FOR LEADERSHIP
IN THE NEW ECONOMIC AGE**

**Edward M. Baker, Director
Quality Planning and Statistical Methods
Ford Motor Company**

**Dr. William G. Hunter
Conference on Quality**

**Madison, Wisconsin
April 19-21, 1989**

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The "New Economic Age"

American enterprises have lost their leadership position to foreign competition as suppliers of high quality goods and services to world markets. Quality has become the primary differentiator in the marketplace. Customers are becoming increasingly more discerning and demanding. Each new level of product and service quality which enterprise provides establishes a new minimum threshold of customers' expectations. Enterprises with the capability to improve and innovate products and services have the key to marketplace leadership.

This is not just a problem for business. It is a national issue which all types of enterprises -- manufacturing and service, government and education -- must address, preferably together. Dr. Deming has characterized the world we now live in as a new economic age requiring innovation in products and processes, particularly processes of communication and cooperation. The implication for enterprise is clear. If it continues to do what it has done in the past, the country as a whole will continue to pay the price.

Role of the Chief Executive Officer

The senior executive of every enterprise has a role to play in helping American enterprises serve their customers by providing the leadership to create a new organizational capability to innovate and improve. This will require an overhaul of all systems and processes, but primarily the management and social processes. This paper promotes a different kind of role for the Chief Executive: Head of Research and Development for the Enterprise.

The viewpoint presented in this paper is that:

1. Incremental improvements or linear extensions of current systems won't be sufficient for long term success in the New Economic Age. A transformation to a new form or state is needed.
2. New models and images are needed to stimulate research and experimentation with innovative processes and systems.
3. Experimentation will lead to learning and eventually will produce a profound transformation of enterprise. Experimentation must be guided by what Dr. Deming calls profound knowledge. This includes:
 - . statistical theory
 - . systems theory
 - . knowledge of psychology and social systems

The ideas are relevant to all CEO's and other top managers, of all enterprises. Since people are the source of innovation, and people are the products of our educational processes, the CEOs of America's educational institutions have a critical role to play in the transformation of America's enterprises (more on this later).

Constraining Influences of Traditional Models and Images

The ability of people to change and innovate is limited by the models and assumptions they use to navigate through life. Models shape perceptions of events. Models can be useful. They give people frames of reference for understanding the world. Changing models, beliefs and assumptions about the world can be an unsettling affair even when a case can be made that old ones are misleading or are inhibitors to improvement. Moving from the familiar and comfortable to the unfamiliar can be anxiety provoking for most people.

One example is Dr. Deming's challenge to statistician's traditional beliefs that the use of probability statements in the form of confidence intervals and significance levels just do not provide information needed for planning of change and improvement. Dr. Deming's way of thinking is contrary to current teaching and practice of statistics. Generations of teachers have rewarded their students for this type of thinking and behavior. People find it difficult to accept new models when the old ones seem to be believed and accepted by everyone around them.

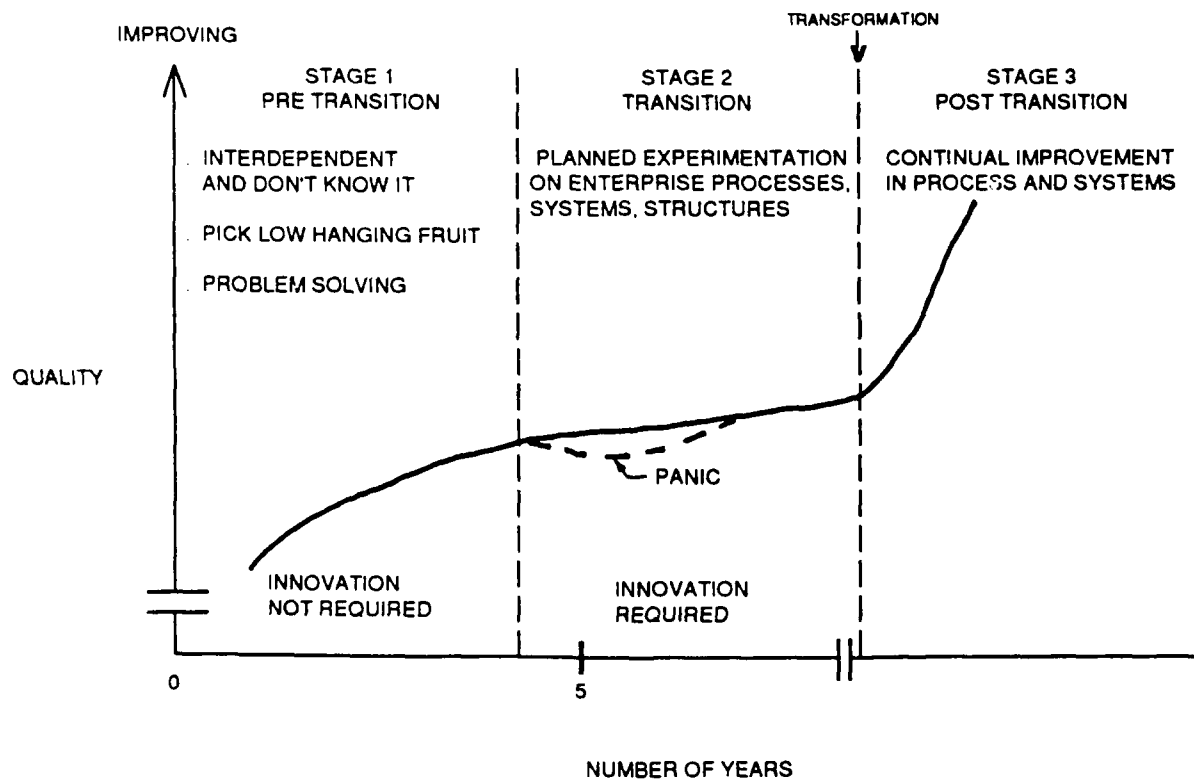
A major inhibitor to improvement in society is rooted in current assumptions and beliefs about cooperation and competition. Alfie Kohn, influenced by the thinking of Steven Jay Gould (reference provides examples of Gould's current thinking), questions 1) the appropriateness of the biological model of competition and survival to explain human behavior, and 2) the evidence for the Darwinian biological model that views competition as a natural state of life on this planet, characterized by a struggle for survival and competition to rise to the top. Kohn observes that competition exists not because it is our nature, but because of "economic or psychological deficits" that can be corrected. Competitive behavior is not a natural state of man or beast. Kohn and Gould argue that Darwin's model and metaphors -- natural selection and struggle for existence -- do not depend on competition for their validity. Struggle can be a cooperative effort to overcome the limitations of nature or disasters.

Stages in the Evolution of a Quality Culture

The transition to a new form of organization can be viewed as consisting of three stages:

1. Pre transition
2. Transition
3. Post transition (transformed organization)

ENTERPRISE'S EVOLUTION TO A QUALITY CULTURE



Stage 1: Pre transition

Quality comes to be recognized, by consumer and producer, as a differentiating factor in the marketplace. Quality, however, is defined by the producer in a negative sense, as the absence of defects. Innovation in process is not required, just hard work, resolve, and attention to detail to prevent defective products from reaching customers.

Value is not really provided to the customer in the form of positive features and performance. However, some incremental improvements may be made in the form of defect reduction, warranty cost reduction, and perhaps -- but not necessarily -- customer satisfaction. In the final analysis, the customer is not the focus of quality. The engineering specifications define what is acceptable or unacceptable. The specifications may not be a good surrogate for what customers want and expect. Even if they are, defining quality as the absence of defects (failure to meet product specifications) won't guarantee customer satisfaction. The best that can be done is to meet customers' minimum expectations (or hopes) of zero defects. This strategy will most likely produce bland, unexciting products with a neutral customer response.

Imagine a waiter taking orders in a restaurant by asking customers what they do not like. It could take several hours (or longer depending on the waiter's deductive powers) for an acceptable meal to be served. Customers most likely would not be too delighted with the restaurant. The zero defects strategy would waste the time and money of the restaurant as well as the customers who end up paying for the waste in the price of the meal. A competitor restaurant that knew how to quickly and directly satisfy customers with a quality dining experience at a price that represents value would soon get all of the business.

Other characteristics of enterprises in Stage 1 are listed in the left hand column of Table 1. The primary improvement strategy in Stage 1 consists of copying the features of enterprises, often referred to as "best-in-class", that have good quality and cost performance. The symptoms of success rather than the causes are copied. Dr. Deming has observed that Americans tried to copy from the Japanese, but did not know what to copy. For example, many American firms tried to implant Japanese Quality Circles. However, the implants were subsequently rejected by their host American cultures.

Dr. Russell Ackoff has a metaphor that puts the copying strategy in proper perspective. Let's say a company wanted to build the best performing car. It could bring every competitor's model into a garage. Engineers would then test and inspect all of the cars, noting which has the best transmission, best radiator, and so on. Then the best parts would be taken off the cars and assembled into a new vehicle.

Would this be the best car? Its not likely that the car would even run. Why? Because the quality of a system --mechanical or otherwise-- occurs at the interfaces between the components of the system and in their contribution to the larger system in which they function. The parts of the system do not have value by themselves, but only in the way they relate to each other and serve the greater good -- the purpose of the larger system, of the whole.

Now, if one knew how to copy a system, then copying might be a valid strategy for avoiding product development costs and the product could be offered at lower prices than the competitors. But, this strategy is devoid of innovation and that is what is needed for the long run success of the enterprise.

Eventually, events occur within the enterprise that mark the end of Stage 1 and start of Stage 2. Quality comes to be viewed in terms of the customers' needs expectations and environment.

Stage 2: Transition to the Transformation

The enterprise's concept of quality expands and encompasses two points of view, the customers' and the enterprise's.

Customers:

Customers, not the producer, are viewed as the judges of quality. Customers evaluate products and services according to how well they meet and go beyond their and needs, expectations, and imagination over the life of the product and at a total cost that represents value.

The Enterprise:

Although customers judge the quality, the producer, as Dr. Deming observes, provides the quality. The enterprise learns how to improve and innovate. Customers' expectations are shaped by what the enterprise and its competitors already have provided. A once exciting product will lose that image when subsequent product and service innovations reach the marketplace. Improvement and innovation is needed to go beyond customer's expectations.

This is the transition period which prepares the enterprise for the transformation -- for the change of state. It is a period of planned experimentation and learning about current and alternative management, social and technical processes and systems. Research is guided by scientific method (The Deming/Shewhart Cycle) and "profound knowledge" from statistical theory, systems theory, and psychology. Change is planned and tried out and learning takes place which is then used for replanning. Experimentation is all the more difficult because it has to take place while the enterprise conducts business.

The time to complete the transition should be measured in generations. The goal is the eventual profound transformation of a management system that has existed for thousands of years in the form of the hierarchical military and church model of organization and became the preferred model for the organization of mass production systems.

Larry Miller, in his book Bureaucrats to Barbarians: Life Cycles of the Organization observed that enterprises that begin life with the innovative products of entrepreneurial minds and spirits evolve to the hierarchical bureaucratic form as the business grows. Many eventually lose the characteristics that initially made them successful. They become rigid in their thinking, highly proceduralized and finally pass on to another world. Some do find a balance between entrepreneurship and bureaucracy.

There are no laws of which I am aware that require the enterprise to evolve to the pyramid type of hierarchy. Alternative organization models and principles are just not well known. Many are waiting to be discovered.

Listed below are some characteristics which I believe characterize most American enterprises, and an alternative vision derived from psychology, statistical theory and systems theory which represents dramatically different ways of operating. An enterprise characterized by the right hand column will have the capability to shape a favorable future for itself and society. The CEO must provide the leadership and environment for research and experimentation in processes and systems that will facilitate the transition to a transformed state.

Table 1

Role of the CEO: Providing Leadership for the Transition

From Traditional
Thinking, Believing, Behaving

The enterprise is a collection of separate highly specialized individuals and units linked within the functional hierarchy. Lateral connections are made by intermediaries close to the top of the provinces.

People are viewed as a commodity, interchangeable, and developed based on the perceived needs of the enterprise. People are passive contributors, with little autonomy, doing what they are told and nothing more.

To Future
Thinking, Believing, Behaving

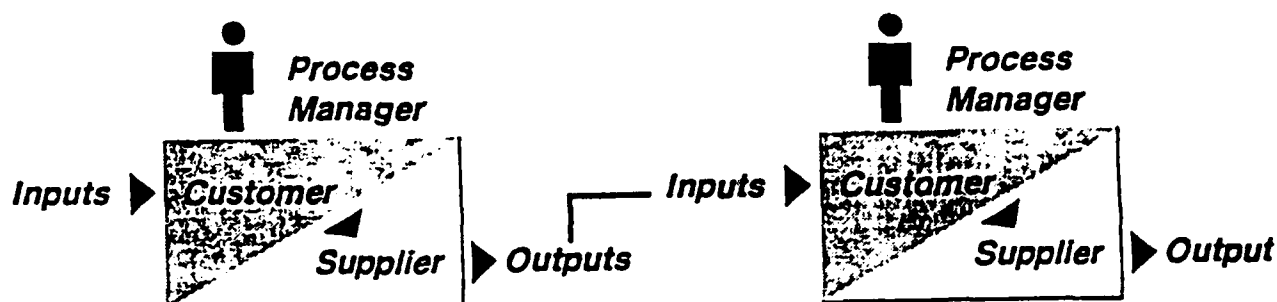
The enterprise is a system of interdependent process linked laterally, over time, through a network of collaborating suppliers and customers. Processes are connected to the enterprise's mission and purpose through a hierarchy of micro to macro processes. Every process (core process) contains subprocesses (micro processes) and is also contained within a higher order (macro or supra) process. The structure of a process is repeated throughout the hierarchy.

People are the enterprise's true competitive edge. Leadership provides people with opportunities for personal growth and development. In so doing, people are able to take joy and pride through learning and accomplishment, and the capability of the enterprise to succeed is enhanced. People are active contributors, valued for their creativity and intelligence.

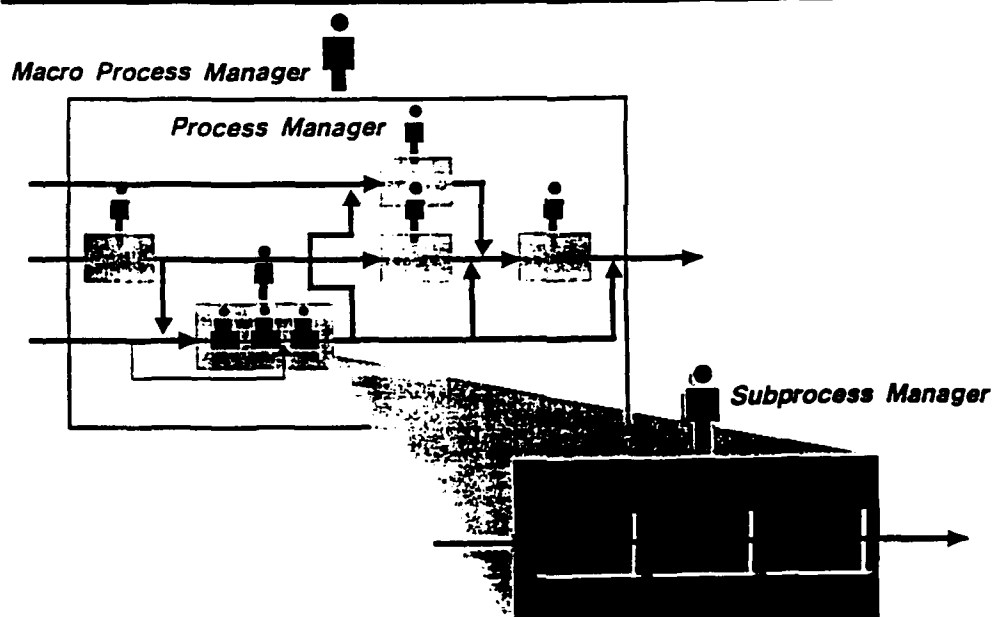
Every person is a process manager, presiding over the transformation of inputs to outputs of greater value to the enterprise and to the ultimate customer.

Every person has a dual role:

- **Supplier to Customers**
- **Customer of Suppliers**



HIERARCHY OF PROCESS NETWORKS



Quality is defined as adherence to internal specifications and standards. Quality, therefore, is measured only by the absence of defects. Inspection of people's work by others is needed to control defects. Innovation is not required.

Quality is defined in a positive sense as products and services beyond present needs and expectations of customers. Innovation is required.

The functional provinces are in a zero sum game where there must be a loser for every winner. People cannot be expected to cooperate unless it serves their own or their unit's best interests. Parochialism is a fact of business life.

Quality embodies knowledge applicable only to manufacturing and engineering.

Statistics is a methodology only for quality specialists.

Managers manage departments or functions or collections of individuals. The pieces do not know they are interdependent. They each act as if they were the whole.

Problems are the result of individual people or departments not doing their best.

Self-interest and the greater good are served simultaneously by serving one's customers. Everyone wins or no one wins. To quote Dr. Deming, "business is not a game".

Quality embodies knowledge applicable to all of the disciplines of the enterprise.

Statistical thinking and methods provide the profound knowledge necessary for management leadership.

Managers manage interdependent systems and processes and exercise managerial leadership through participative management in carrying out their roles as mentors, facilitators, innovators, etc.

Quality results from the interaction of the enterprises' systems. People working in the system can not do better than the system allows. The vast majority of problems will be prevented and improvement will be promoted when people understand where they fit in and have the knowledge to maximize their contribution to the whole. Only management can create the environment that nurtures a team oriented culture that can prevent problems and continually improve.

Performance appraisal, recognition and reward systems place people in an internally competitive environment. Individualism is reinforced to the detriment of teamwork.

Once the organization has found a formula for success, it keeps following it. Management's job, therefore, is to prevent change; to maintain the status quo

The adversarial relationship between union and management is inevitable. The only area for negotiation is in the traditional areas such as wages, health and safety.

Hierarchical "chimney" organization structures promote identification with functions and tend to create competition, conflict and adversarial relations between functions.

Reward systems recognize individual as well as team contributions and reinforce cooperation.

The environment in which the enterprise interacts is changing. If the enterprise continues to do what it has done in the past, its future performance, relative to the competition, will deteriorate. Managements' job, therefore, is to provide the leadership for continual improvement and innovation in processes and systems, products and services. External change is inevitable, but a favorable future can be shaped.

The union is a partner and stakeholder in the success of the enterprise. The areas for partnership and collaboration are broad, particularly in education, training and meaningful involvement of employees in the improvement of the processes which they affect and which affect their work.

Formal and informal mechanisms encourage and facilitate teamwork and team development across the entire enterprise.

Suppliers are to be pitted against each other to get the lowest price. The more suppliers competing against each other the better it is for the customer company.

Internal stability and good control are defined by absence of negative deviations to plans and objectives. If these occur, find (and blame) the individual responsible. If there is time, fix the problem.

Managing means maintaining a stable internal state. Mechanistic management principles and rigid structures are needed for control and avoidance of change.

Control is achieved by pre-established, inflexible responsive patterns given in the "book" of rules and procedures. People are customers of the "book", which prescribes appropriate behaviors.

Customers are outside of the enterprise and are within the domain of marketing and sales.

Suppliers are partners with their customers. The aim of the partnership is innovation, reduction in variation of critical characteristics, lower costs, better quality. The aim may be enhanced by reducing the number of suppliers and establishing long term relationships.

Stability and control are statistically defined by the natural variation of the process. Improvement and innovation comes from working on the system of common, mutually interacting causes if the pattern of variation indicates stability.

Managing means maintaining a balance between prevention of change and creation of positive change. Management structures enable learning and self-organization in order to anticipate and meet changing environments and new situations.

"Scientific methods" of research with statistical and other tools enable people to study and improve their processes.

Control is achieved by enterprise shared values and beliefs, knowledge of mission, purpose, and customer requirements.

Everyone inside the enterprise is a customer of an internal or external supplier. Marketing concepts and tools can be used to assess internal customer needs and communicate internal supplier capabilities.

The manager's job is to do the subordinates' planning, and inspect the work to make sure the plans are followed.

The manager's job is to manage his or her own process and relationships with others and give subordinates the capability to do the same. To quote the title of Dr. Aaron Beck's book, Love is not Enough

Managers provide leadership rather than over-invention in the processes of their subordinates, who are viewed as process managers rather than functional specialists.

Motivation is achieved by aversive control. People are motivated to do what they do in order to avoid failure and punishment, rather than contribute something of value to the enterprise. People are afraid to do anything that would displease the boss or not be in compliance with company regulations. The system makes people feel like losers.

People are motivated to make meaningful contributions to what they believe is an important and noble cause, of value to the enterprise and society. The system enables people to feel like winners.

Competition is inevitable and inherent in human nature.

Competitive behavior -- one person against another or one group against another -- is not a natural state. The competition can be against the environment. or to please the customer, or to eliminate waste of non renewable resources, or to prevent passing on to future generations a damaged planet, incapable of sustaining human life.

Managing The Psychological Transition

The transition of the enterprise to a new envisioned state is will be accompanied by a transition in the psychological state of the people in the enterprise. Movement from the familiar past to an unknown future will produce feelings of anxiety and uncertainty. This psychological transition should be recognized and facilitated. The transition will be facilitated if everyone participates in all stages of the improvement cycle and understands how they will benefit from the changes.

Stage 3: After the Transformation

In Stage 3, innovation and continual improvement is a natural state. The enterprise has gone beyond the ability to adapt to the environment. Adaptation is not enough--it is too late. Animals and plants adapt to a change in their environment in order to survive. But not all adapt. They wait, and if they don't adapt, they die. Adaptation is the wrong model. If the transformation has been successful the enterprise has created a new capability. It can plan, shape, control its internal and external environment and what happens to it.

The Special Role of the CEO of the University

American enterprise needs a new breed of leadership to help in the preparation for the transformation Stage 2 and in the transformed organization, Stage 3. In Stage 2, enterprise needs leaders with the knowledge, skills, values and beliefs to move away from traditional approaches to the way work is accomplished and organizations are managed. Leaders who will create a culture with capability for continual improvement and innovation of its processes and systems, products and services.

To do this, I and my colleagues in the Automotive industry believe, will require innovation in the educational process. University of Michigan President Dr. James Duderstadt stated in his inaugural address (October, 1988) that the University of Michigan was created to meet the needs of society in the 19th and 20th centuries. He challenged his University to examine whether these educational processes will prepare its graduates for the 21st century.

My colleagues and I believe that all educational institutions face this challenge. We do not believe that existing educational processes will produce the new breed of leadership we need. Innovation is needed in the processes of education. The knowledge disciplines exist; that is not the issue. It is the leadership that

integrates them in a meaningful way. An innovative educational process must, in our view, go beyond simply selecting pieces from the separate, specialized departmental offerings. The knowledge, perspectives and languages of the component disciplines have to be integrated into a system of education that optimizes the contribution of the disciplines to what we believe is one of the most important purposes of the educational system -- to develop leaders for new economic age.

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Loubert, S. (1988). Process management: The new role of managers. Available from the Process Management Institute, Inc., One Paramount Plaza, Suite 360, 7801 East Bush Lake Road, Bloomington, MN 55435-3830.

Dr. Loubert discusses the implications of quality improvement efforts for the manager's everyday activity. She asserts that improvement efforts of managers will succeed only if top management becomes directly involved.

An understanding of a few key concepts in the process of improving quality is an important first step in any organizational change process. These are:

--All work is a process;

--Process management facilitates process improvement;

--A control chart provides a guide for appropriate managerial action because it helps management to distinguish between common and special causes of variation;

--The achievement of statistical control and continuous improvement requires teamwork.



Process Management : The New Role of Managers

Dr. Sharon Loubert
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Few would argue with the statement that quality is the responsibility of management. Try to define the implications this has on a manager's job and the debate begins. It's fairly simple to begin creating an environment of continuous improvement. Attend a seminar, undergo training, hire a consultant; all these are important, visible signs of management's commitment to quality. Perhaps you've done all those things, but find that most work still gets done the usual way, i.e. rework, mistakes and firefighting are the norm. Despite some initial successes, the momentum has diminished.

What will sustain the momentum of initial efforts to improve?

Only management's direct involvement can help this situation. The role of management in facilitating process improvement is critical to its survival. Initial successes usually occur because they have high visibility and management is eager to see results. After some time, additional efforts will begin to generate requests for resources or policy changes to enable improvement to take place. An ill-prepared management may not be able to assess requests in terms of their impact on strategic plans, short-term needs and other improvement efforts throughout the organization. Not being able to make timely responses to these requests discourages those people who have given their time and energy seeking opportunities for improvement.

What kind of involvement by management is needed?

To answer this it is necessary to first establish the goals of the involvement (i.e. the why's). The second step addresses the method of achieving them (i.e. the how-to's). Ultimately continuous improvement requires a change in one's way of thinking about work. This takes time, so we need to look at both long-term and short-term goals.

Long-term: change thought processes from

- results-oriented to process-oriented
- firefighting to incremental improvement
- the individual to the team
- deterministic to probabilistic
- the short-term to the long-term
- the quantifiable to the unknown and unknowable

Short-term: enable management to

- plan and monitor improvement efforts
- gain a better understanding of process improvement
- strengthen their commitment
- communicate plans and initial successes to the rest of the organization

How do we begin?

Education is the first step. An understanding of the theory of continuous improvement is necessary. Any number of courses teach the basic problem solving tools (i.e. flowcharts, pareto diagrams, cause and effect diagrams, control charts, histograms and scatter diagrams). These are a necessary ingredient for improvement, but they need a binding theory to be useful. The following key concepts are critical for management to understand.

1. All work is a process.
2. Process management facilitates process improvement.
3. A control chart provides a basis for acting on variation.
4. Achieving statistical control requires teamwork.

Each of these concepts will be described in greater detail. Examples of management processes are also given. The best place to begin application is on your own work, don't limit yourself to the production processes.

Key Concepts

1. All work is a process.

Outside the manufacturing environment this concept is generally not well accepted. Just ask what is the process for determining when to hire new personnel, designing a new product or scheduling capital projects and you'll be surprised at the variation in responses. These processes may be more difficult to define than manufacturing processes since they follow the flow of information through people rather than material through machines. A flow chart takes an invisible process like budget preparation or monthly report generation and makes it visible. Often just the act of flow charting a process improves it by eliminating variation in how things get done. This requires involving the people who work in the process. Seeing the process on paper makes it possible to begin to question it. Do you need the process? Is it too complex? Why do you do it that way? Do you really need all those approval loops? Remember that a flow chart is a means to improvement and not an end in itself.

2. Process management facilitates process improvement.

The objective of process management is to monitor the performance of a process with respect to how well it meets customer requirements. This is best done by the owner of the process, i.e. the person responsible for the output. Every process can be improved, yet with limited resources not every process can be improved at the same time or with equal intensity. The job of a process manager is to prioritize and sustain improvement efforts, support and recognize process participant's efforts to improve, and cultivate innovation.

Once a manager has determined which processes he or she owns, the following steps outline the method of process management.

1. Define the current process.
2. Understand what the process needs to produce and for whom.
3. Determine critical success factors and on-going monitoring methods.
4. Assess the need for improvement and/or innovation and assign the required resources.
5. Continue to monitor the critical success factors.

The critical success factors should answer the question: how will you know if the process has improved? It is important to monitor the variation of these measures of overall performance. Typically these are different from measures needed to improve a process. The objective of process improvement is to identify and reduce causes of variation in the process. This is best done by the participants in the process, i.e. the people closest to the work. These people must identify critical control variables upstream in the process. The following steps outline the method of process improvement.

1. Define the current process.
2. Understand what the process needs to produce and for whom.
3. Identify and measure critical control variables and identify areas for improvement.
4. Analyze the problems/areas for improvement and determine root causes of variation.
5. Improve the process by testing and institutionalizing the change.
6. Continue to monitor control variables and identify new areas for improvement.

Notice that both process management and process improvement begin with developing an understanding of the process and what it needs to provide. Obviously both owner and participants in a process must reach consensus on the process description. This provides management with an opportunity to model the first two steps above. This task shouldn't be delegated and must involve all parties

with a vested interest in the output of the process, i.e. internal and external customers.

The next steps are best accomplished by assembling a team of process participants. The process manager must then provide the team with the resources it needs, e.g. time, additional process expertise, a budget. The process improvement team will be able to go about the business of measuring critical control variables, identifying root causes and making incremental improvements. The manager will be able to monitor overall improvement by charting the critical success factors. The following list cites a few examples of critical variables.

<u>Type of Process</u>	<u>Success Factors</u>	<u>Control Variables</u>
Accounting/ Finance	Budget vs Actual Sales	Pricing Changes Computer Errors
Distribution	Delayed Shipments Inventory Levels	Lead Times Schedule Changes
Safety	Lost Time Accidents Medical Expenditures	Uncovered Hazards Hours of Training
Production	Yields Downtime	Measurement Breakdowns

3. A control chart provides a basis for acting on variation.

Once critical success factors have been determined, you may begin to monitor the performance of a process in terms of how well it meets customer requirements. The data analysis leads to the following questions:

1. When does a particular incident merit an investigation?
2. When should the process be changed?

Without an understanding of special and common causes, rules like the following tend to provide the usual basis for action.

- If expenditures are over budget by more than 10% complete a report citing the reasons.
- Investigate every deduction greater than \$100.
- Reprimand anyone absent 4 days or more.

These rules are usually based on someone's "experience" or "gut feel" or perhaps that's how it's always been done. Is it no wonder that nothing ever seems to get better and the same problems keep coming back? Distinguishing between special and common causes leads to two possible courses of action.

Special Cause:

- immediately investigate the cause
- seek ways to avoid its recurrence
- fix the process as needed

Common Cause:

- continually gather common cause data
- stratify data by type of cause
- identify opportunities for improvement
- improve the process after appropriate analysis and testing

Separating special and common causes prevents one from inappropriately allocating resources to temporary fixes rather than incremental improvements. Nowhere is it appropriate to just fix the process without considering the underlying causes. Nor is it correct to assume that every instance of variation can be attributed to someone or is related to some special event.

Notice what occurs within the airline industry. Major disasters receive intense investigation. Reasons for the accident are cited, people are fired and equipment is submitted to a new set of inspections. Of course an investigation after this highly emotional event is merited, but how much common cause data is accumulated? What about the near misses or the little day-to-day mechanical or service delays? Anyone can predict with near certainty that a major disaster will occur within the next year. Pinpointing when or where one is most likely to occur requires data based knowledge.

Recognize the power of data. This power is easily abused. Numerical figures are seldom void of emotion and may be used to incriminate, blame, convince, or blackmail by those who may not know the limitations of the data.

4. Achieving statistical control requires teamwork.

It is easier to master the technical details of a control chart than to understand how to achieve stability of a process. Statistical control is not a natural state of a process. It requires teamwork to accomplish and on-going monitoring to maintain. Don't be fooled into believing that as long as you see a control chart the process is being "controlled". The following steps describe what needs to be done to begin to achieve statistical control of a process.

1. Form a team of operators, supervisor, engineering and management to define the current process, the necessary requirements and the key quality characteristics.
2. Investigate the relationship between the quality characteristics.
3. The team establishes the initial sampling plans and control charts.
4. The person closest to the process, i.e. the operator, plots the data, notes unusual occurrences and identifies special cause signals.
5. The operator is empowered to investigate special causes and suggest ways to prevent their recurrence.
6. Operator and supervisor determine appropriate action and work to prevent recurrence.
7. Management takes appropriate action when the cause is beyond the scope of the supervisor.

It is apparent that achieving statistical control is much more than simply plotting points on a control chart. Management must be prepared to support the above steps before asking for processes to be "in control".

Management commitment is a difficult thing to prove. However it is clear that actions speak louder than words. These four concepts are not meant to encompass everything you need to know about continuous improvement, but provide guidance for appropriate management actions. Whether beginning to create a culture of continuous improvement or trying to sustain initial efforts, management involvement is critical. It's never too soon to begin or too late to start.

PROCESS MANAGEMENT INSTITUTE, INC. (PMI) is a Minneapolis based consulting company dedicated to working with organizations who are seeking to implement continuous quality improvement through the adoption of the Deming Philosophy. PMI provides statistical and IQMP consulting, conducts public and private client seminars on Deming philosophy and statistical training and supports client instructors with training materials.

Sharon Loubert received her Ph.D. degree in Statistics from Iowa State University. Dr. Loubert works with PMI clients to help them develop a "Total Quality Organization" by applying the Deming philosophy throughout the organization.

Baker, E. M. (November 1987). The quality professional's role in the new economic age. Quality Progress, 20(11), 20-28.

In this landmark article, Baker defines competitive viability as synonymous with total organizational quality, the capability of an organization to continually assess and translate customer requirements into the requirements of the organization's processes. Total quality lowers the cost of doing business because it frees the organization of resources whose sole function is to cope with expected process breakdowns.

Baker describes several steps that he believes are essential for the successful achievement of organizational transformation in the face of external environmental change. Baker believes that the process of transformation should be one of stable change as the organization learns what new forms to take through planned observation, experimentation, and study; existing structures and management practices should not be abandoned overnight. The role of the quality professional as a facilitator of organizational change is discussed.

The Quality Professional's Role in the New Economic Age

The quality profession can play a vital part in a company's efforts to maintain stability while transforming itself

by
Edward M. Baker

NORTH AMERICAN BUSINESS is going through a period of explosive, accelerating change in its competitive external environment. This is increasing the pressure on firms to change internal systems to more competitive ways of operating. Each year, the number of technological innovations seems to double while the time for that technology to find its way into the market in the form of goods and services is shrinking—almost halving. Instant electronic communication, rapid global travel, and other forms of immediate gratification of needs are continually changing consumer expectations, habits, and behavior patterns. Consumers are on the lookout for products and services that gratify needs that they can't yet imagine.

D.A. Schon has called the phenomenon of rapid change the "loss of the stable state."¹ He has observed that most of the technological knowledge existing at any time within the past few hundred years has been discovered within the memory of those alive. As the time to diffuse technology to the consumer has shrunk—from generations to a fraction of a generation—problems of adaptation have increased. Alvin Toffler has noted the "generalized speedup of the corporate metabolism" and observes that many business people and executives see the certain world they once knew "tearing apart under the impact of an accelerating wave of change."² W. Edwards Deming has provided management with a new set of principles for operating in the "new economic age."³

The enterprise of the 1990s has to develop the capability to simultaneously:

- maintain consistent, repeatable production processes—to prevent change.
- continually transform its processes, systems, and structures to take competitive advantage of ever-diminishing periods of environment stability.

Nature teaches us that organisms that are highly specialized for a specific purpose and a given environment become extinct when the environment changes and they do not. In the new economic

age, the successful enterprise will develop a capability for stable self transformation—to manage its own change without throwing itself into a state of chaos.

To accomplish this difficult goal, management must create the environment for intelligent and cooperative interaction between the many internal functions of the enterprise. At the same time, management must involve all members of the organization in the transformation and improvement of the systems and processes in which they work. People's expectations about work, their role, and the rewards provided by the enterprise also have changed dramatically over the decades. A large gap exists between people's potential ability and their actual commitment to perform.⁴ Yet commitment must be high if people are to contribute fully their knowledge, skills, intellect, and creativity to help the enterprise improve. Management's leadership can provide the vision to unify the enterprise, create commitment, and transform that commitment to action.

Technical foul for quality interference

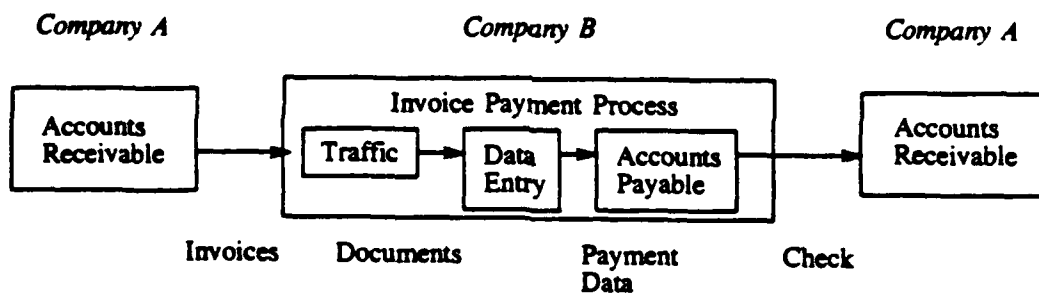
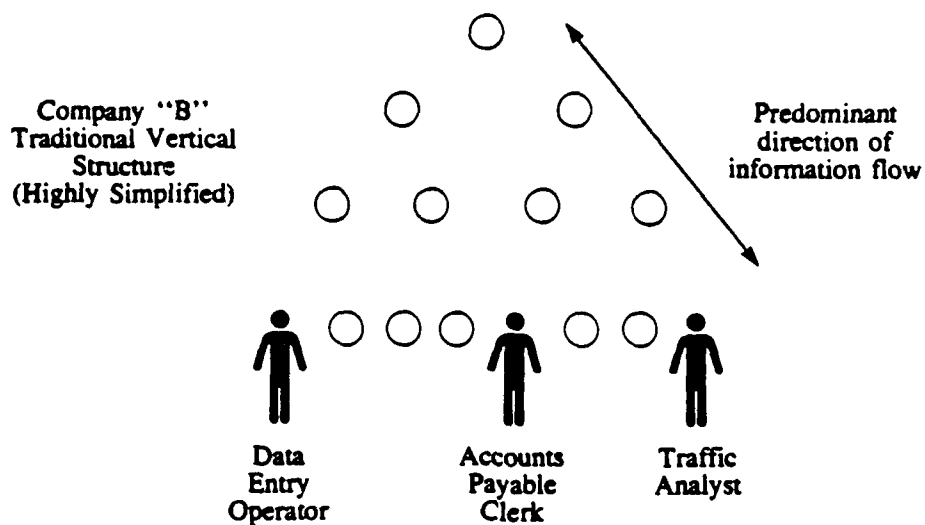
Competitive viability is synonymous with total organizational quality, the capability to continually assess and translate customer requirements into the requirements of the organization's processes. In order for these processes to produce real value (in terms of product/service features, performance, and price) for customers, they must be freed from waste and resources whose sole function is to cope with expected process breakdowns. Each part of the process should add something the customer values rather than remove something the customer does not want. Total quality lowers the cost of doing business.

The natural flow of processes is horizontal—lateral—but the paths, channels, and pipelines are vertical. Most of today's enterprises are still structured according to mechanistic principles of operation (left side of the scale in Table 1) established at the beginning of the twentieth century under very different economic,

Table 1.
The Future Role of the Quality Professional:
Helping the Enterprise Make the Transformation

<i>From</i> <i>Thinking, Believing, Acting as if:</i>	<i>To</i> <i>Thinking, Believing, Acting as if:</i>
<ul style="list-style-type: none"> • The enterprise operates in a static, unchanging environment. • Internal stability and good control are defined by absence of negative deviations to plans and objectives. If these occur, find (and blame) the individual responsible. If there is time, fix the problem. • Managing means maintaining a stable internal state. Mechanistic management principles and rigid structures are needed for control and avoidance of change. • Control is achieved by pre-established, inflexible response patterns given in the "book" of rules and procedures. People are customers of the "book," which prescribes appropriate behaviors. • Customers are outside of the enterprise and are within the domain of marketing and sales. • The functional provinces are in a zero sum game where there must be a loser for every winner. People cannot be expected to cooperate unless it serves their own or their unit's best interests. Parochialism is a fact of business life. • The enterprise is a collection of separate highly specialized individuals and units linked within the functional hierarchy. Lateral connections are made by intermediaries close to the top of the provinces. • The manager's job is to do the subordinates' planning, and inspect the work to make sure plans are followed. • People are passive contributors, with little autonomy, doing what they are told and nothing more. 	<ul style="list-style-type: none"> • Explosive external change is inevitable and provides opportunities for those able to create competitive advantage from change. • Stability and control are statistically defined by the natural variation of the process. Improvement comes from working on the system of common, mutually interacting causes if the pattern of variation indicates stability; otherwise, leave it to the discretion of local "process managers" to identify and remove "special causes" if they can. If not, provide help. • Managing means maintaining a balance between prevention of change and creation of positive change. Management structures enable learning and self-organization in order to anticipate and meet changing environments and new situations. "Scientific methods" of research with statistical and other tools enable people to study and improve their processes. • Control is achieved by enterprise shared values and beliefs, knowledge of mission, purpose, and customer requirements. • Everyone inside the enterprise is a customer of an internal or external supplier. Marketing concepts and tools can be used to assess internal customer needs and communicate internal supplier capabilities. • Self-interest and the greater good are served simultaneously by serving one's customers. Everyone wins or no one wins. • The enterprise is a system of interdependent processes linked laterally through a network of collaborating suppliers and customers. The processing systems are connected to the enterprise's mission and purpose through a vertical hierarchy of micro to macro processes. • The manager's job is to manage his or her own process and its interfaces and give subordinates the capability to do the same. Managers provide leadership rather than over-intervention in the processes of their subordinates, who are viewed as process managers. • People are active contributors, valued for their creativity and intelligence.

Figure 1. Process Quality Possibilities in a Functional Hierarchy



Possible
Process
Flows

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

Quality at the Process Interfaces

- = ok (on time, no errors, complete, etc.)
● = not ok (late, errors, incomplete, etc.)

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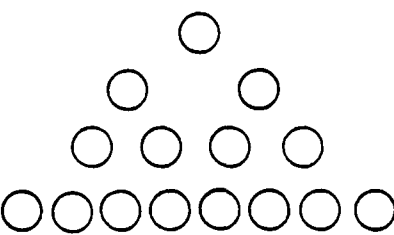
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Quality Delivered
to Final Customer

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Figure 2. Complexity in the functional hierarchy inhibits process quality

Traditional Structure (Highly Simplified)	Level in Hierarchy	Number of Cousins (People at the Same Level) When Span of Control = 2	Potential Lateral Interfaces
	0	$2^0 = 1$	$\frac{1}{2}(1 \times 0) = 0$
	1	$2^1 = 2$	$\frac{1}{2}(2 \times 1) = 1$
	2	$2^2 = 4$	$\frac{1}{2}(4 \times 3) = 6$
	3	$2^3 = 8$	$\frac{1}{2}(8 \times 7) = 28$
		<u>15 people</u>	<u>35 lateral</u>

Total number of interfaces = $\frac{1}{2}(15 \times 14) = 105$
(lateral + vertical + diagonal)

NOTE: n is the number of people. Number of interfaces = $\frac{1}{2}[n(n-1)]$

technological, and social conditions. The vertically structured, functionally oriented organization was designed and operated to cope with the needs of machines, not people. Machines had to be maintained to protect the company's capital investment. The system behaved as if people were expendable commodities along with other inputs to the machines. These structures fragment the processes of the enterprise and inhibit quality. They are not attuned to dealing with the needs of people.

Functionally oriented, vertical management structures present obstacles to quality—even when everyone has the best intentions, commitment, desire, and philosophy. The complexity in most enterprises offers too many opportunities for the process to fail. Figure 1 shows how quality is likely to be degraded as a product or service moves through a functionally organized hierarchy. In this example, the process—the payment of supplier invoices—appears to be simple. Company A bills Company B for products and services it has provided and in turn becomes the customer of Company B's invoice payment process. This process involves three of the eight specialists at the bottom of the organizational pyramid. It is likely that these individuals in these functions do not view themselves as part of a broader process or perceive their work as serving a customer. Let's say that Company A's quality requirements for payment are that the check be:

- paid on time.
- completed without errors in amount or other information.
- accompanied by accurate and complete documentation.

It is useful to look at the process as a network of supplier-customer interfaces, with each processing system playing first the role of customer/user of inputs and then of supplier/producer of outputs. Figure 1 shows eight ways for the process to operate. Failure to meet final customer requirements can be caused by failure to meet internal customer requirements at any stage of the process. Any failure along the way adds cost in the form of time for redo, compensation for delays (e.g., premium mail), transmis-

sion and possible amplification of errors, customer inquiries that must be answered or returns that must be reworked, and internal customer requests for proper information to complete the transaction. The additional waste of inspection and checking (usually by the supervisor) that characterize poor quality processes is not shown—nor is the employee demoralization that accompanies such activities.

Of the eight possible ways for this process to operate, only the first meets the requirements of accounts receivable. If each of the eight combinations is equally likely, the final customer will be satisfied only one time in eight while being subject to errors, delays, or incomplete information seven times in eight. Like most processes, this one—if left to chance—will deliver poor quality more often than not. Thus, the ability of each stage to meet the requirements of the next customer must be assured. This implies that each supplier/producer identify customers, define their requirements, and determine what is needed to meet them. Assuring the interface is difficult in the vertically structured enterprise.

Figure 2 shows the difficulty of direct, unobstructed communication between internal customers and suppliers in the functional hierarchy. The organization is highly simplified, depicting only three levels below the top executive and a span of control of two. Thirty-five lateral interfaces are possible. The 28 possible interfaces between technical specialists at the bottom of the organization is four times the number of interfaces possible at the supervisory and management levels. Yet, traditional vertically oriented structures add complexity by requiring even more intermediaries, the bosses, adding time and people to the process. Often, the people at the bottom of the hierarchy do not know with whom—or if they do know, they just don't have the autonomy—to communicate directly. When you add in the vertical and diagonal interfaces, there are 105 possible two-person relationships. Some of these represent what should be explicit supplier-customer interfaces.

Figure 3. Proliferation of Complexity with Vertical Height (Number of Levels)
(Shown: Six-Level Hierarchy with Span of Control = 3)

Level	Number of Cousins = 3^{Level}	
0	$3^0 = 1$	
1	$3^1 = 3$	
2	$3^2 = 9$	
3	$3^3 = 27$	
4	$3^4 = 81$	
5	$3^5 = 243$	
6	$3^6 = 729$	
<hr/>		
1,093 People		
		Number of Interfaces = $\frac{1}{2}(1,093 \times 1,092) = 596,778$

When the situation is made just a bit more complex (Figure 3)—but still not as complex as the organizational charts in many enterprises—with six levels below the top and a span of control of three, one finds 1,093 people, with 596,777 possible interactions. This makes it difficult to determine:

- Which interfaces are necessary?
- With whom to link? When? How often?
- Who depends on whom—who are the customers and who are the suppliers in the potential relationship?
- What are the customer's requirements? What are the supplier's capabilities?

To further complicate matters, these questions must be answered in the context of a dynamic external environment. Finally, this illustration doesn't capture the intensity of the frustration and conflict that usually accompanies process failures and makes them even worse. People's feelings about the organization are intimately and intricately interwoven with its quality capability. Fragmentation of the process not only wastes large amounts of the enterprise's productive resources, but also replaces the satisfaction that comes from success with a feeling of personal failure and its correlates: frustration, blame, recrimination, and conflict. People give up: most people in large organizations are not entrepreneurs and will not persist or challenge the bureaucracy when faced with adversity; they lose their commitment to the organization and their trust in management.

What type of transformation is needed?

The culture of an enterprise is shaped by the products and services the organization provides. Furthermore, cultures vary among the functions of a single firm, depending on the amount of repetition and stability or creativity and innovation required. One of management's critical tasks is to create a vision of where the firm should be to thrive, define the current state of affairs, plan how to move toward the vision, and then do it. People in the enterprise must be taught to cope with change so rapid it seems continuous; the capability to accelerate needed internal change is a key to competitive viability.

Competitive viability demands a culture of unity with flexibility, of autonomy with collaboration, of stability with change. The enterprise needs new images of organization—or rather old images. Many large firms started out as small entrepreneurial activities. People who were there at the beginning may remember the early days of the business—the closeness of the people, the ability to communicate face to face, the dedication and spirit, the

absence of rules and procedures. A few people executed all of the business functions. They knew the customer and they knew that their purpose was to serve the customer. They were innovative and able to change to meet the changing needs of the customer. But as success led to growth, external complexity was matched—even exceeded—by internal complexity resulting from attempts to achieve control by specialization and fragmentation into functional provinces. The characteristics that made the firm successful—innovation, quick response, ability to change—were lost.

The enterprise needs to bring back this capability. While it needs sufficient internal stability to reproduce goods and services consistently for the markets it has created, it needs an organization that is loose enough—sufficiently flexible and adaptive—to respond to the demands and opportunities created by external change.

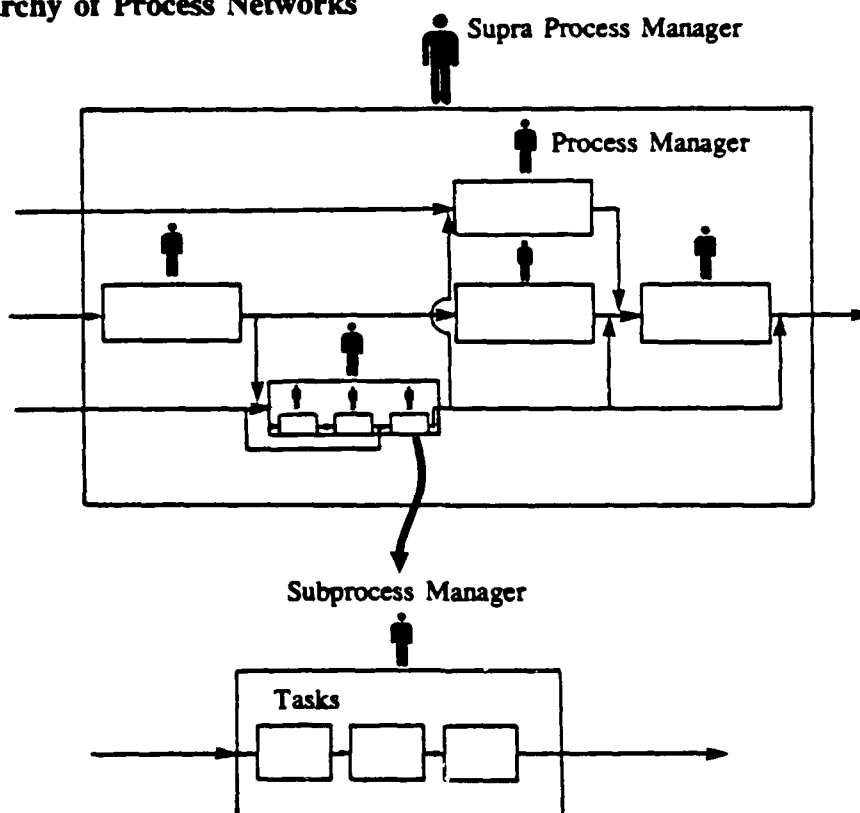
If the enterprise is to become competent in dealing with external change, its processes—their parts and the relationships between them—must be able to change. People, as part of interdependent processing systems, need to have the autonomy and capability to reorganize themselves, to form and reform the process connections to change what they do and how they do it to meet new and changing external conditions. As the networks reform, the specific interfaces may change along with the mutual requirements of suppliers and customers who make up the interfaces.

Under these circumstances, stability will come to refer more and more to processes of managing change, rather than to preventing change. Thus, the enterprise needs new models, images, and principles of organization and management. Table 1 is an attempt to define both ends of a scale that ranges from a tightly controlled, rigid enterprise that is not good at dealing with external change, to a flexible organization with the ability to keep up with a changing environment.

There is no single right way to accomplish the transformation from a rigid bureaucracy to a flexible enterprise. Moving from vertical, functionally oriented management principles, systems, and structures to lateral, process-oriented ones requires a new perspective about what it means to manage and control; in the new economic age, everyone in the enterprise can be viewed as a process manager. This movement also requires thinking in terms of wholes and relationships rather than functions and fragments; the hierarchy can be viewed as a network of processes, as shown in Figure 4, rather than a collection of functions. Many paths lead to this desired vision. It is a process of discovery and learning.

The initial challenge is education. Change is a process of learning, of gaining new knowledge and skills. It must be preceded

Figure 4. Hierarchy of Process Networks



by learning how to learn; learning to remove the barriers to learning. Children are good learners because they have little in the way of preconceived notions to block and filter out ideas. Adults often have difficulty learning because new ideas conflict with existing habits, values, beliefs, etc., which once served a need or function but now must be unlearned or discarded. People in the enterprise need the ability to know when former ways no longer serve the purpose of the organization and must be changed.

Consider how a person learns a complex skill such as playing a musical instrument, speaking a foreign language, or driving a car. Initially, the new driver holds tightly to the wheel. While trying to maintain a straight path, the learner over-steers in one direction, then tries to compensate by over-steering in the opposite direction. Driving along the highway or merging into traffic, the novice disrupts the other drivers and interferes with the smooth flow of traffic. But, as the learner becomes competent, control actions are fewer and more subtle; transitions from one activity to the next are smooth. The individual is in harmony with the external environment rather than disrupting it. In today's world of rapid change, the functional bureaucracy often behaves like a new and still unskilled learner, over-adjusting, unable to make smooth linkages between segments of the process, unable to operate in harmony internally and with the external environment. But how can the bureaucracy learn when traditional systems, principles, and structures were designed to prevent learning and change?

In these circumstances, even people of good will seem unable to do anything about the fragmentation of the enterprise and the associated cycle of waste and frustration. People tend to look upward to their bosses, downward to their subordinates, and sideways to their cousins in other functions for the solution (or blame).

The challenge to the enterprise, especially at the top, is to let go of the archaic ways of thinking about how to organize resources. Existing structures cannot and should not be dismantled overnight; rather, the process should be one of stable change as the organization learns what new forms to take through planned observation, experimentation, and study (as shown in Figure 5). But, certainly people can learn to operate as if they were part of an interdependent system with a common purpose rather than a collection of independent units.

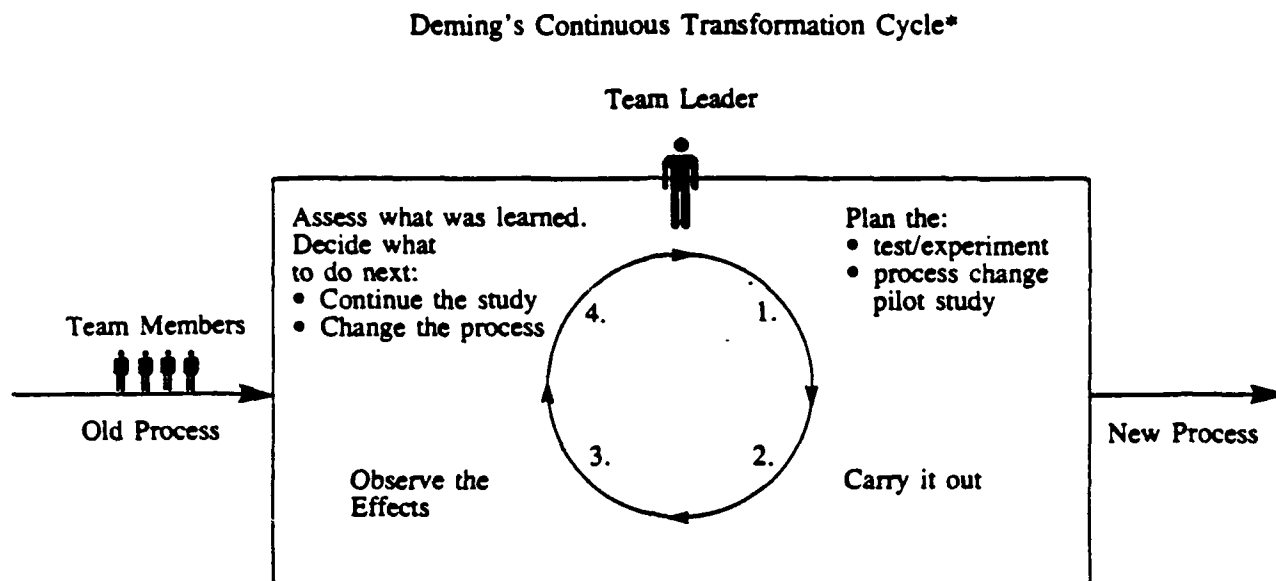
Components of the transformation

How can we accomplish the transformation needed to maintain competitiveness in the face of external change? There is no one way, but some basic characteristics of the flexible, adaptive organization can be described.

1. The enterprise has defined its purpose and desired quality culture. These are critical first steps in the transformation. These steps often are overlooked or not specifically addressed because they appear so simple. They are important for two reasons. First, they require discussion and clarification at the top of the enterprise and subsequently throughout the entire organization. Second, they help top management decide if it really wants to change. Without top management belief that change is necessary, there won't be the leadership to energize the rest of the organization.

All of the enterprise's systems and activities derive from its purpose, its reason for existence. A quality-oriented purpose should be conceptualized and defined in terms of the customer. The culture defines how people are expected to behave: what's right and what's wrong. It provides norms and principles to guide the behavior and judgment of members of the enterprise. It states

Figure 5. Scientific Method for Learning About and Improving the Processes of the Enterprise



*See Deming, 1986, p. 88; See Juran's (1964) Breakthrough Sequence

values regarding people, product, and service: how customers and suppliers are to be treated and how everyone in the company should treat one another. It enables people to make decisions in the best interests of the enterprise when faced with new situations. It provides guidance for redesign of the enterprise's systems.

As the purpose of the enterprise—and the principles guiding its transformation—are communicated through the organization, people may observe contradictions between the vision of how things should be and the reality of the way things are. These contradictions will arise, but it must be understood that the vision is an ideal to work continually toward rather than something that always will be achieved. As the enterprise moves away from bureaucratic modes of operation, people will find it easier to live according to the desired values. The vision of purpose and culture should be reevaluated periodically as the enterprise learns more about itself from its customers, and its members, and as the environment changes.

2. Quality improvement planning is integral to the long-term health of the business. Because such planning provides resources and accountability for the process of change, rather than merely for today's results, it balances today's needs with tomorrow's.

3. Processes are managed as integrated systems—that is, they are seen as flowing laterally, without regard to provincial boundaries, rather than as a static collection of separate functions. Integration refers also to the melding of the social and technical systems. Improvement is accelerated when individuals:

- have a holistic view of what they do and where they fit that goes beyond their own discipline, specialty, and functional province.
- understand the enterprise as a network of processing systems in supplier-customer relationships.
- understand that the quality culture is customer driven. The

supplier's process requirements are derived from—and are surrogates for—the customer's requirements, not the supplier's needs. On a larger scale, the enterprise is not its own customer, adhering to its own specifications, oblivious to the changes in the outside world.

- understand that they and others in the organization have obligations and responsibilities resulting from each person's dual roles as customer and supplier.

- define teamwork as collaboration between customers and suppliers to meet customers' needs and improve the suppliers' capability to meet those needs.

- view customer needs as positive requirements to be actively achieved rather than as negative product and service characteristics to be avoided.

4. The purpose, management principles, and culture of the enterprise are the bases for changes in the system—changes accomplished by getting everyone involved in improving the processes that they manage. All people, management and nonmanagement, feel responsible for, and participate in, process improvement studies. The micro-systems of the specialists and the macro-systems of the managers are subject to the same improvement principles, processes, methods, and tools. These methods are applied at a level of understanding and detail appropriate for the complexity of the processes over which the individual presides.

5. The learning process (Figure 5) underlies the planned and stable change of all systems: technical, social, and management. The Deming-Shewhart cycle⁵ and Juran breakthrough sequence⁶ are examples of the "scientific method" that can be used to teach everyone in the firm to learn how to learn. It is extremely effective when applied by process improvement teams of suppliers and customers, whether on the shop floor, in the engineering office,⁷ in the finance office, or in the executive suite.

Planned change is data-based and therefore requires statistical theory and methodologies to determine if there is a stable baseline from which to plan and evaluate change—if there is evidence of a system of multiple, common, interdependent causes that can be studied and changed, or rather of a series of somewhat unpredictable, even chaotic events indicating that a system doesn't even exist.

6. Planned change is also emotion-based—it takes into account people's feelings and fears about how the change will affect them. (Will they be hurt or will they benefit? Can they trust a changed future to be better than the present?) Even when people understand that change is necessary, it is often difficult for individuals to change personally for two reasons:

- They do not believe that change will improve their own lot in life.

- They do not believe that they can participate in bringing about positive change.

These feelings are rooted in the nature of the functional hierarchy. For years, employees (including middle management) have been conditioned to believe they cannot and should not control events and that their lives are in the hands of others—that the "system" will handle it. This is especially true in large companies that have reached middle age and substituted procedures for personal relationships based on mutual trust and common purpose. People are too embedded in the functional provinces to break out on their own, even when they want to and know they ought to change. They are afraid of change; history has robbed them of the confidence that they can create a favorable future, and it has not provided the process for gaining and applying the knowledge needed to plan and create change.

A "third party" (internal or external) can help break down the provincial barriers and create the mutual trust needed for collaboration. It is unreasonable to expect this to come from within the provinces and their members—they need outside help plus the leadership of top management to create a positive vision of the future.

Implications for the quality professional

Quality traditionally has been viewed as the technical province and responsibility of people in the "quality department." The "quality professional," as a member of the quality department, has operated in and supported the types of systems defined by the left side of Table 1. The job was designed for a world of stability and certainty. Tactics have focused on detecting, removing, and preventing nonconformities in order to forever meet the specifications. The emphasis has been on avoiding negatives rather than on achieving positives through continuous assessment of customer needs and improvement of processing systems to anticipate and meet those needs and strengthen customer loyalty. As change becomes a way of life inside the enterprise, quality strategy and methodologies that have been concerned with maintaining stability will have to be altered to promote change. The customer's threshold for quality is continually being raised. While zero defects may be the producer's end goal, it is the customer's minimum expectation. It does not assure competitive advantage. It gets the enterprise a spot on the starting line, but doesn't guarantee winning the race.

Quality will come to be understood as inherent in every process and the responsibility of every person as a "process manager." The transformation, therefore, will involve the entire enterprise, treated as a whole, rather than as disconnected programs. The traditional domain of the quality professional, however, has been the manufacturing operation. Competitive viability requires that quality principles and concepts encompass all of the firm's func-

tions and activities in a holistic, integrated, process-oriented manner. The interfaces that link process to process are as critical as the processes themselves. A process has no purpose if its products and services do not serve a customer, and a process cannot serve a customer if it does not receive what it needs from its suppliers. Every function and every individual in the firm participates in the organization's processes as a supplier and as a customer: everyone can benefit from an education in the generic quality principles and methods that can be applied to improve any process and its relationships with other processes. The role of the quality professional will have to expand to one of consultant to management throughout the enterprise.

The transformation will be social as well as technical. Process interfaces should be viewed as relationships between people, which involve feelings and interpersonal communication. Quality professionals traditionally have not been involved in creating the social-cultural conditions needed to develop and nurture teamwork, collaboration, and personal commitment to other colleagues in the enterprise. People's feelings and opinions about each other and about the firm reflect the social effects of the firm's systems and can provide valid indications of what needs to be changed. This implies that the quality professional will have to treat these "soft" data as valid information and learn appropriate methods for analyzing them.

The failure to create supportive social conditions is documented by the failure of most American attempts to transplant Japanese quality circles into the soil of American business culture.⁸ Circles didn't take root because the management, technical, and social systems were mechanistic and fragmented. Companies tried to install the circles rather than create the climate needed for them to grow. Many of these attempts were managed within the domain of quality control. Sidney Rubinstein has tried (unsuccessfully for the most part) for more than two decades to help his colleagues in the quality profession recognize that a total quality system must explicitly integrate the design of the management and technical systems with people's needs, desires, and abilities.⁹ It follows that quality can benefit from the involvement of employees in the design and change of the systems within which they work. In most firms, improvement of the work climate, especially through employee participation, has been the responsibility of industrial relations managers and human resources specialists. Where employees are represented by a union, management-employee relationships have been addressed within the traditional structures and roles of professional industrial relations and union intermediaries. Rubinstein's work has demonstrated that processes and structures can be redesigned to create new collaborative roles and relationships with the direct participation of all management, union, and employee stakeholders.¹⁰

Enlightened senior managers in major North American companies are starting to view quality as a generic business function.^{11,12,13} Quality professionals have been instrumental in designing and carrying out transformation activities within a number of firms: process-oriented thinking has been used to integrate business functions and improve quality and productivity within a highly layered, vertical management structure.^{14,15,16,17,18}

These are initial efforts to overcome the bureaucracy and represent a continuing process of learning and change. The number of firms undergoing this type of transformation will undoubtedly grow rapidly in the next decade. There is no alternative. During the past decade, the Japanese have developed quality function deployment¹⁹ to integrate the functions of the business within the framework of company-wide quality control. This discipline is being studied by a growing number of North American companies.

In order to guide all members of the enterprise through the

transformation, the quality professional will have to work with other change agents to educate and train, consult, and remove barriers to change while promoting creativity and innovation. The quality professional's effectiveness will be enhanced by participation in the following interrelated activities:

1. Development of communication and influence networks. An alliance of quality professionals, statisticians, organization development professionals, training specialists, and other experts can collaborate as an internal resource team, even if members are not in the same organizational unit. External consultants can be considered part of the team. In addition to helping the internal consultants with strategy and tactics, they can promote transformation at the top of the organization by playing a role that management might be unlikely to accept from internal experts, even if technically competent. Organization change consultants can diagnose the strengths and weaknesses of management styles and relationships at the top of the organization and provide the feedback and guidance that must precede effective change. They can help top management define the enterprise's purpose and culture, plan the broad change, and provide feedback to the executives regarding their own performance in managing change. Statisticians (Deming-type) can help management understand that improvement lies in changing the systems of the enterprise.

The quality professional should also develop an internal network of implementers, which can help build a critical mass, particularly if it includes key staff and line managers and is linked to the network of specialists and to the top management teams leading the transformation. At the same time, an external network of people in other companies attempting a similar transformation can accelerate learning about useful approaches.

Similarly, the top executive, who has no "cousins" within the firm, can benefit from mentoring by a cousin from another company who has been through a similar change process and is willing to help the senior executive. The mentor can help clarify the top executive's role and create realistic expectations of the normal ups and downs that occur during times of change. External consultants should be able to find mentors in their client firms.

2. Consulting skills improvement. Quality professionals may come to view themselves as representing the desires and vision of top management, but this doesn't guarantee acceptance by others in the organization: people may say that they are in total agreement that the firm is on the right path and would love to participate, but that day-to-day pressures take priority. The consultant must know how to "sell" the advantages of process improvement. A consultant must also know when to try a different approach. Unwillingness to participate may be caused by fear of change.

Internal change agents should become educated in methods of large system change, particularly with regard to people issues,^{20,21,22,23} as well as gaining competence in techniques of small group management.^{24,25,26} These skills will be useful in managing process teams whose members will likely report to different functional managers.

The conduct of process studies will be improved by learning more about Deming's statistical theories, general systems theory, and the "scientific method" exemplified by Deming's continuous improvement cycle and Juran's breakthrough sequence, both of which are processes for discovering what aspects of the system to change.

3. Promotion and marketing. The quality professional must constantly educate others in the company, especially people outside of manufacturing, about the new role of professionals in the quality organizations and the multidisciplinary approach to change. This includes advertising successes by multimedia documentation, especially videotapes.

Finally, the quality professional should have influential and committed managers educate their colleagues in the firm.

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About the Author

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SECTION V: IMPROVEMENT OF ORGANIZATIONAL PROCESSES: THEORY AND APPLICATION

Fuller, F. T. (Autumn 1985). Eliminating complexity from work: Improving productivity by enhancing quality. National Productivity Review, 4(4), 327-344.

Moen, R. D., & Nolan, T. W. (September 1987). Process improvement: A step-by-step approach to analyzing and improving a process. Quality Progress, 20(9), 62-68.

Hoffer, W. (April 1988). Errors on the job can be reduced. Nation's Business, 76(4), 62-64.

Houston, A., & Dockstader, S. L. (December 1988). A total quality management process improvement model (NPRDC Tech. Rep. 89-3). San Diego: Navy Personnel Research and Development Center.

Once management has created a climate that is supportive of organizational improvement efforts, several statistical tools can be used effectively to study organizational processes and identify opportunities for improvement. This set of papers describes such tools and suggests how they may be used to collect and analyze data on organizational processes and to guide improvement efforts.

Fuller, F. T. (Autumn 1985). Eliminating complexity from work: Improving productivity by enhancing quality. National Productivity Review, 4(4), 327-344.

This is one of the most useful articles written to date for understanding and improving processes. It provides a general framework by which any process can be improved.

Each step of a process should provide value to the customer rather than remove something that the customer does not want. Fuller provides a method for systematic identification of the elements of a process that exist solely to remedy expected process breakdowns and for assessing their cost to the organization. If the organization can identify and eliminate the "extra work" from its processes, it can reduce greatly the complexity and additional costs that the work brings to the organization.

The simple and elegant framework delineated by Fuller may be applied to identification of sources of waste in any process, whether in a service, manufacturing, or administrative environment. Fuller uses two case examples to illustrate application of his method.

Eliminating Complexity from Work: Improving Productivity by Enhancing Quality

A significant portion of work activities is performed just to find and fix errors. A procedure for identifying such activities is proposed.

F. Timothy Fuller

Introduction

With the emergence of Japan as the worldwide quality and productivity leader in a number of industries, many U.S. manufacturers are embarking on companywide programs of quality and productivity improvement. Many of these programs have been sparked by the teachings of W. Edwards Deming, the man who has been given credit for teaching the Japanese his powerful philosophy of making decisions based upon statistical principles. Hewlett-Packard is one of those companies studying and attempting to implement Deming's philosophy of managing better.

The Computer Systems Division of HP began in 1981 to use Deming's methods in the manufactur-

ing of its line of HP3000 general purpose business computers. A consultant, familiar with Deming's work, had helped guide a number of successful projects in the department that assembled and tested printed circuit boards. The results of these projects were the virtual elimination of solder joint defects and associated rework, reduction in component insertion defects, improvement in manufacturing cycle time, and reductions of inventory and space requirements.

After studying the results of the initial projects, managers in the division were beginning to realize that every time defects were reduced, productivity rose measurably. This increase in productivity could often be attributed to reduction in rework that followed the reduction of defects.

In late 1983 management was looking for more

The problem of back orders was not considered serious enough to make improvement a high priority objective.

ways to improve productivity of the circuit board assembly process. The problems associated with late delivery of materials seemed to be a likely candidate for study and improvement. This study led to some manufacturing changes that produced startling improvements in productivity.

The success of these efforts convinced the author that tremendous productivity gains could be achieved by reducing the unnecessary work, or complexity, introduced by defects in the quality of materials, tools, equipment, and other process variables. This article is concerned with finding, measuring, and eliminating complexity in the work place.

Complexity in manufacturing: the back order problem

The assembly process for printed circuit boards in the Computer Systems Division consisted of a number of steps, beginning with gathering a kit of parts, continuing with auto inserting, hand loading, wave soldering, and back loading, and ending with testing. Boards were built with lot sizes of 20 to 200 and were controlled through work orders issued through the material requirements planning (MRP) system. Work orders were started as close as possible to the time that kits were issued, even if some of the parts were missing.

When the assembly process was started before all parts were in hand, the process would generally proceed as far as the wave solder operation. If the missing parts had not arrived by this step, the partially completed boards were pulled off the line and stored on shelves. When the missing parts arrived, the partially completed assemblies were brought back to the line and the assembly process continued.

The logic behind the process of building incomplete kits was related to two beliefs held by management:

1. It is important to keep people busy working, even if the overall task cannot be completed. If production workers are idled by missing parts, labor hours are wasted.
2. In order to meet production schedules, the assembly should proceed as far as possible so that

when the missing part arrives, it can be quickly inserted and the lot of boards can be expedited through the remainder of the process.

Data which had been collected on the parts back order problem showed that, on average, about 98 percent of the kit parts were in the stores area when the work orders were pulled. Materials management felt that due to the number of vendor problems and the variation in the production schedule, this performance was acceptable. However, from the point of view of the production department, it was less than desirable. Since the majority of the kits required as many as 100 different parts, numerous kits had back-ordered parts when they were pulled to the production floor. The data showed that about 75 percent of all the kits pulled had one or more back orders when delivered and that, on the average, each kit had from one to three missing parts.

Production management had been working with the materials group for some time to improve the availability of parts but was unable to achieve higher than the 98 percent in-stock level.

Awareness of the problem

Although management was aware that back orders were a problem, it was not considered serious enough to make improvement a high priority objective. Most similar assembly operations in the company were experiencing the same degree of difficulty in procuring parts. One of the reasons for this was high demand in the chip market, which was causing a number of suppliers to miss promised shipping dates or to allocate scarce parts among their customers instead of sending complete orders.

One particular event raised the back order problem to a higher priority within the management group. The assembly department of the Computer Systems Division had been experiencing a higher than normal demand for completed boards and was having difficulty meeting the production schedules. A neighboring division was faced with less than expected demand for its products and had a number of surplus production workers. An agreement was worked out to borrow some of these workers to help the assembly operation.

After a week or two in their temporary assignment, the loaned workers approached management with complaints about the working conditions in the assembly department. Their comments included statements like, "We don't like working here. Things are too disorganized," and "Every time we start working on something, we run out of parts and have to find something else to work on. We didn't have these problems at our other job."

The assembly management was quite concerned over these comments, especially because it had thought that the department was quite well organized and that morale was relatively high. When asked about the differences between the two departments, the loaned employees stated that in their own department no work orders were started until the kits were complete.

The new process

The department manager thought about these comments and decided to try an experiment to eliminate the problems associated with back orders. He proceeded to modify the parts-pulling process as follows:

1. Stores would continue to pull kits of parts according to the MRP schedule.
2. Complete kits were to be delivered to the assembly area as usual.
3. Incomplete kits were to be placed on shelves in the hallway with a note indicating which parts were missing.
4. When the back orders were filled, the completed kits would be delivered to the assembly floor.

The production control supervisor confronted the assembly management with the prediction that "If you let work orders sit around and don't start working on them, you will never meet your production schedules," but the assembly manager held firm and the experiment was begun on a Monday. Immediately, material began to build up on the shelves in the hallway. The work load in the assembly area began to slow noticeably. When work-in-process began to flow out of the area, the supervisors showed some nervousness as they saw their people idle more and more

often. For the first week very little new material flowed into the department.

One day the department manager found a supervisor rummaging through the incomplete kits in the hallway trying to combine two partial kits to make one full kit in order to give some work to his people. The manager asked him not to do that. "Instead," he said, "why not do some training? Hold your staff meeting. If you've nothing else to do, take your crew to a movie. Just don't be concerned if your people aren't busy. I'm not measuring supervisors on how busy their people are any more." He also requested that they not expedite late parts. He suggested that they wait until the kits were complete and then do their best to build them as quickly as possible.

Soon the material in the hallway became noticeable to higher division managers. "You can't have a million dollars worth of expensive RAM's sitting in the hallway like this. There's no control," they said. Moreover, the division managers were not convinced that the experiment would work. But they supported its continuation. A compromise was reached whereby the incomplete kits would be stored in a special area that could be more tightly controlled.

In addition to the lack of work in the assembly department, other changes became noticeable. The work-in-process shelves gradually emptied as more of the old back orders were filled. The department manager decided that it might be possible to eliminate some of the shelves. Some of the idle production workers were given the task of dismantling the shelves and getting rid of them. Significant pockets of vacant space opened up in various parts of the department, and it began to take on a cleaner look. Three weeks after the experiment began, almost all of the work-in-process shelves had been emptied.

The remarkable results

As the experiment went into its fourth week, the manager noticed that the production workers were still often idle, even though work had begun to flow through the process again. A quick check of the production output showed that weekly production had climbed back to the level maintained before the experiment began. He also noted that a number of the

As the work-in-process queues disappeared, an extreme variability in work load became visible.

production workers had been loaned to work in other departments.

Concerned, he asked for a review of the actual hours of work being recorded to build a set of boards and compared this to the current labor standards. Incredibly, the amount of labor to assemble a kit of boards had been cut nearly in half by this single process change.

It appeared that as much as half the activities of about sixty people had been to set up and take down jobs, expedite, move material, count material, and do other tasks that were unnecessary in the new process.

As the department began to adjust to the new procedure, other problems began to surface. As the work-in-process queues disappeared, an extreme variability in work load became visible. At times the workers were almost idle; at others they were inundated with work. Previously, the work-in-process queues had hidden the variation. Production control was called in to study the problem; as a result of the study, lot sizes were reduced significantly. Smaller lots of each board type would be delivered several times each week. High-volume assemblies would be delivered daily. It also became apparent that the new process could not tolerate significant downtime of critical equipment, such as the automatic insertion and automatic test equipment.

The data now showed that a significant reduction in cycle time had been achieved. With the reduction in lot sizes not yet in effect, the cycle time appeared to average five and one-half days, down from sixteen and one-half days before the experiment. Sorting the cycle time data by lot size revealed that further improvements would be achieved as smaller lots reached the assembly area.

The manager decided to collect more data to see how the new process affected his ability to expedite critical boards that were late because of missing parts. Data from before the experiment showed that if a lot of boards was partially assembled up to the wave solder step, it would take approximately two days to expedite them through the process when the missing parts arrived. Data now showed that a lot of boards could be expedited through the entire process, from start to finish, in less than twelve hours. Production control's prediction had been proven wrong.

Clearly, the experiment was a success. Significant improvements in every measure of productivity

had been achieved by improving the quality of the incoming kits. It should also be noted that no additional work was required of anyone outside the production department. The data showed a tight link between quality and productivity. Improved quality had eliminated the need for many complex process steps. Less complexity meant less work required to produce a given output.

Let's now look at a model of this process change and describe in detail how this improved quality leads to a reduction in complexity and increased productivity.

The complexity model

Figure 1 is a process flow diagram of a simple assembly process. The process is designed to have three steps: get the kit, assemble it, and move the material. If one asked supervisors to draw a flow diagram of such a process, most of the diagrams would look like this one. However, if one actually followed the flow of material through the shop, one would probably find many more steps in the process than are shown here. The extra steps would in most cases be related to unexpected problems such as late parts, defective parts, and poor procedures.

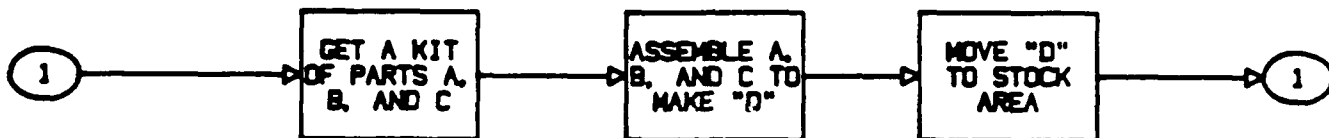
Why would most supervisors leave out these critical steps? One reason may be that Figure 1 represents the most common path through the process. Another reason may be that the process was designed this way by the supervisor and, due to lack of knowledge of the process, he or she thinks it operates this way, or at least wishes it would operate this way. In any case, we know that in the real world problems do come up and they have to be dealt with.

Let's now add a quality problem to the perfect process shown in Figure 1. Suppose that when a worker goes to pick up a kit, one of the three parts is missing. Also assume that our standard operating rule is to try to keep busy and work around problems as best we can. How could we redraw the Figure 1 diagram to show the additional steps needed to handle the problem of missing parts? Figure 2 shows how this new process might look.

Across the top of the diagram one additional step has been added to the process, an inspection step.

Figure 1
The Perfect Assembly Process

NO COMPLEXITY



The person who picks up the kit of parts now is required to make a decision: if all the parts are in the kit, the standard process applies; if one of the three parts is missing, there are some different steps to follow. Let's suppose that inspection finds that one of the parts is missing. Now we must know which one is missing, because in order to partially build the assembly, we need to know which of three special procedures to follow.

The next step is to assemble the parts on hand and then find a place to store the material until the missing parts show up. In order to keep track of all the work in process, a special log or computer entry may be required to describe the location of the WIP.

The job has thus become more challenging for employees. More training is required because there are more than twice as many process steps for them to perform. More space is required to store the WIP. A cabinet may be needed to store the procedures. In some cases an employee with a higher level of skills may be required to perform the work.

Also, another process has been added for the supervisor. In the perfect process shown in Figure 1, the supervisor could spend all available time hiring, training, and otherwise helping his or her employees develop good work skills. In the first process the supervisor played no part in the actual accomplishment of the tasks. Once he or she was trained, the worker had complete control of all the steps of the process.

In our new process the supervisor has many

new jobs to do. The supervisor may have a "hot list" of all the critical parts he or she is waiting for and another list of customers with the most urgent needs for late assemblies. The supervisor now becomes an expeditor in order to attempt to satisfy his or her customers. The supervisor will also likely be the one who goes to get the critical parts the minute they arrive in the stockroom, the normal delivery procedure being much too slow.

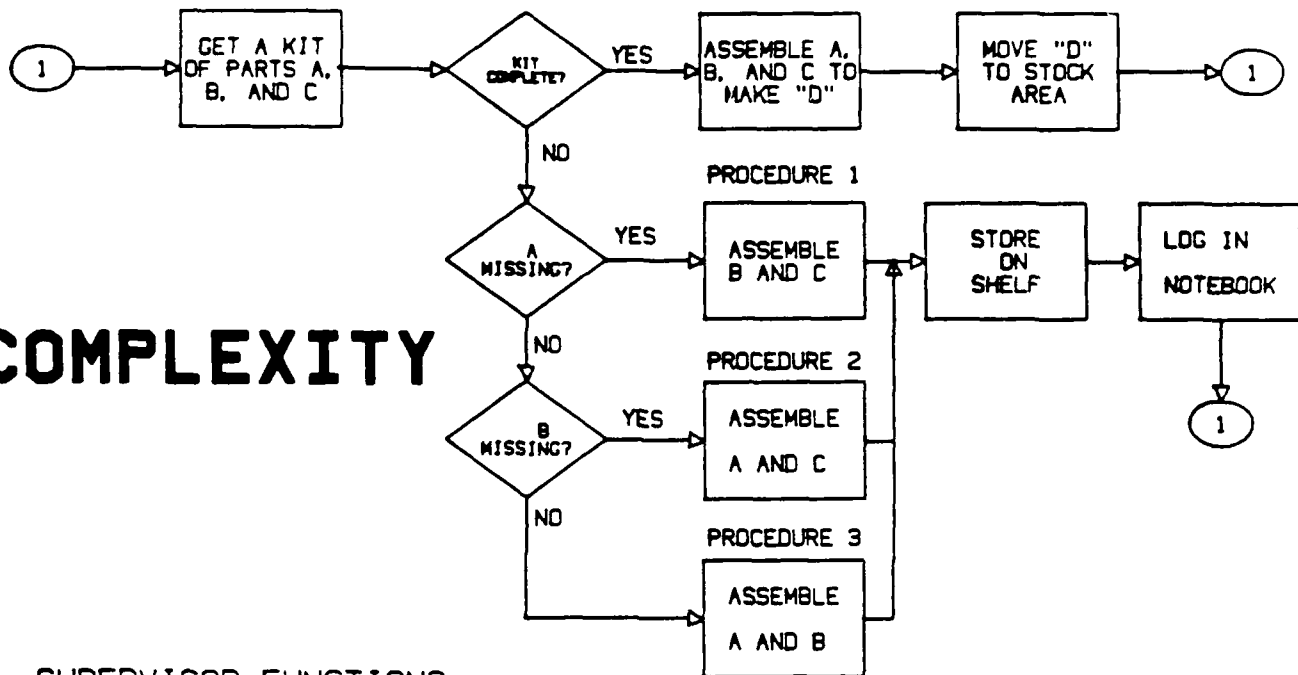
Once the parts are in hand, the supervisor must find someone to install them. He or she must decide who should be interrupted and must ask the employees who are selected to put away their current work and set up and perform the critical work. The supervisor may help by finding and retrieving the partially completed assembly. When the job is complete, the supervisor may be the one to deliver it to the customer, as the delivery system may again be too slow.

Enumerating the extra work

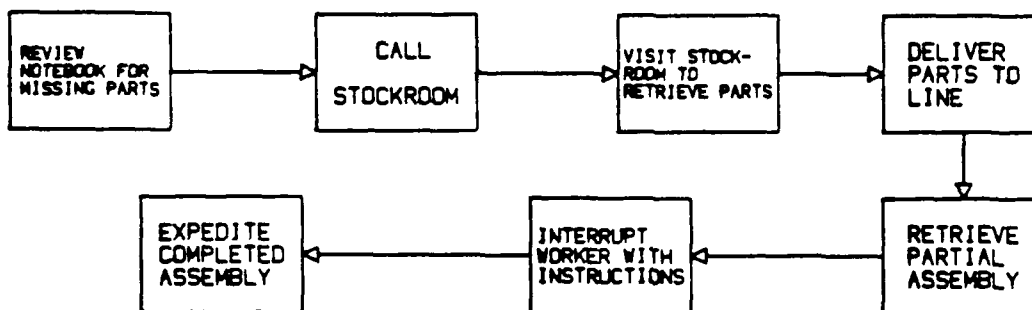
Now we have two processes, and the second one just described clearly involves more work than the process described in Figure 1. In the second process, each time a kit is received an extra inspection step is required; so even the error-free process takes a little longer. In addition, when a missing part is discovered, many extra steps are required. The second

COMPLEXITY

Figure 2
An Assembly Process with Errors



SUPERVISOR FUNCTIONS



process will always take more time than the first and will require several times more work than the first if every kit has one part missing.

However, we have only begun to enumerate the extra work associated with the second process. Let's assume that at every step of the process, errors can be made. In the simple process, errors could be made in three places. The worker could get the wrong kit of parts; a mistake could be made in the assembly step; and the completed assembly could be delivered to the wrong place. The frequency of errors will de-

pend on a number of things, but the quality of the initial training and the amount of practice the worker has had will certainly be the main contributors.

With relatively few different types of possible errors, the recovery process for each error can be described and practiced. Therefore, we can assume that the simple process will probably have relatively few errors, each of which can be quickly corrected.

But in our second process we have a different situation. We can expect a few more errors in the standard procedure (the top line of steps in Figure 2)

Process complexity is the extra process steps required to deal with external and internal errors.

because there is an extra step in each repetition of the process. What can we expect in the special steps required to handle missing parts?

Since some of these process steps are performed infrequently, the worker may have little chance to practice them. In addition, the initial training may not cover all the possible steps in the process. This implies that the error rate may be substantially higher in these nonstandard steps. Now consider what happens when the worker tries to recover from a second-level error.

Suppose that part "B" is missing from the kit and an attempt to put "A" and "C" together is made. Let's also suppose that a mistake is made when the entry is made in the log that records the location of the partially completed assembly. Now when the parts arrive and the partially completed assemblies can't be found, what process should be followed to find the assemblies and get things straightened out?

It is likely that a new procedure will be invented on the spot to handle what has now become a crisis. It is at this point when things really begin to go wrong. Tempers get short, one person blames another for the problem, and so on.

Let's now define process complexity as being extra process steps that are required to deal with external errors ahead of the process or extra process steps to recover from errors in the process, or internal errors. Reducing external and internal errors improves productivity through the following sequence:

1. Error reduction permits elimination of some process steps, such as disposition of faulty material, and reduction of the number of times that some process steps, such as rework, need be repeated.

2. Now that less rework steps are being performed, there is less chance of internal errors. This reduces some lower level rework steps. Fewer rework steps at this lower level lessens the chance of internal errors at that level and therefore reduces the number of rework steps at a still lower level, and so on.

In sum, reducing errors can lead to elimination of work at multiple levels of the process and therefore highly leverages productivity improvement.

Experience has shown that eliminating errors will produce extensive gains in productivity that far exceed potential gains achieved by trying to improve the efficiency of an error-ridden process. Automation

of an assembly process that is full of errors will likely force everyone into a crisis situation. Implementation of Just-in-Time manufacturing techniques (JIT or Kanban) without first reducing quality problems will likely have similar results.

Our model has suggested that the addition of one external quality problem to a perfect process can introduce a significant amount of complexity that substantially reduces productivity. In the majority of departments, whether manufacturing or administrative, most standard processes have far more steps than the simple one in our model. In addition, many types of errors can flow into the process and many other types can be introduced into the process itself. Every error requires extra process steps to deal with it. If the error is not discovered in the process, the customer will likely find it and will be required to deal with it.

This implies that in most processes in our offices and factories where no long-term process improvement efforts have been in place, most of the activities undertaken by people are part of the complexity and few activities represent the "real work" that people would like to be doing. As William Conway, former president of Nashua Company, put it, "There's just not much work in anything."

How to find the complexity

We have shown that in a typical operation or department, much of the work being done might be complexity that has been introduced by errors. Unfortunately, much of this complexity is usually not apparent to the manager of the department. We have been doing these unnecessary tasks for so long that we see them as part of the standard process.

Some people have jobs that are largely the result of errors which have been introduced into the system. Consider these examples:

1. A person who opens and restocks customer returns;
2. A customer service representative who follows up on customer complaints;
3. A collector who calls customers who are late in paying for merchandise;
4. An expeditor of late parts or products; and
5. An inspector who looks for defects.

***Time unavailable for work is as high as
25 percent of the total time in large organizations.***

All people who are engaged in performing a standard process spend some portion of their time solving problems. All people make mistakes and must correct them. However these activities are seen as normal parts of their jobs, and no special notice is taken of them. If a copy machine breaks down occasionally and sometimes produces poor copies, working around the inconveniences is considered the mark of a good, resourceful employee. Each employee builds into this job some informal procedures to overcome the little problems faced each day.

Only when several copy machines break down at the same time and there are loud complaints does management grasp that there is a problem that needs to be solved. Now something will be done, even if it is only a temporary solution to get the work moving again. Let's explore some techniques we can use to begin to find and measure the complexity in an op-

eration. Then we can discuss some techniques for removing it.

The "real work" model

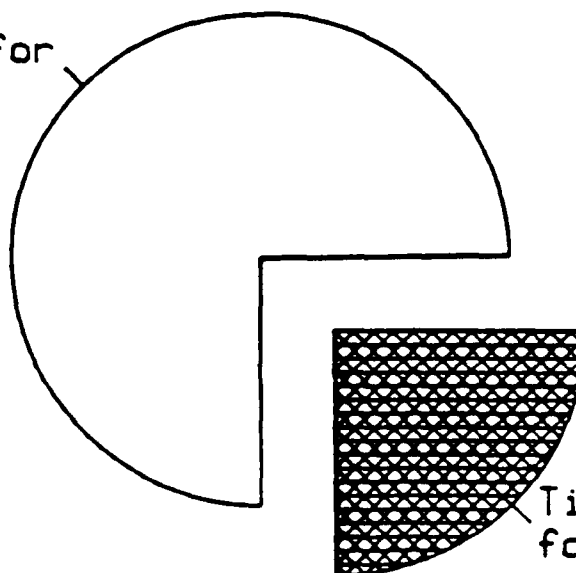
Figure 3 depicts that part of a typical employee's time during which no work is possible. The circle represents the total eight-hour work day. The shaded area is an estimate of the time that is lost due to sanctioned benefits, company-sponsored activities, and unsanctioned business that take the employee out of the work place. Some examples of sanctioned benefits are vacation time, coffee breaks, and sick leave. Company-sponsored activities include staff meetings, training, United Fund meetings, and fire drills. Unsanctioned personal business includes unscheduled

Figure 3

COMPLEXITY MODEL

Amount of Time Not Available For Work

Time Available for
Real Work



Time Unavailable
for Work

rest breaks, personal phone calls, late arrival, and early departure.

It has been the author's experience that this unavailable time is as high as 25 percent of the total time in large organizations with a full range of employee benefits. This leaves approximately 75 percent of the eight-hour day that potentially could be used for doing work.

Complexity caused by external errors

Now let's make some estimate of the activities that are going on during the remaining hours. From the back order case discussed earlier, we can estimate that, on average, people spend up to half their working time fixing problems caused by errors introduced into their process from other sources. The activities com-

prising this time are designated in Figure 4 as complexity due to external errors. Added to time unavailable for work, it further reduces the amount of time available for "real work," which can be defined as activities that an organization is in business to carry out and that, in the absence of errors, would still be performed. Now only 35-40 percent of people's time is available for real work. Table 1 lists examples for five departments of activities representing real work and complexity resulting from external errors.

Complexity caused by internal errors

Referring back to the complexity model presented earlier, we recall that even a process using high quality materials will still have internal process errors.

Figure 4

COMPLEXITY MODEL

Amount of Time Lost Due to External Errors

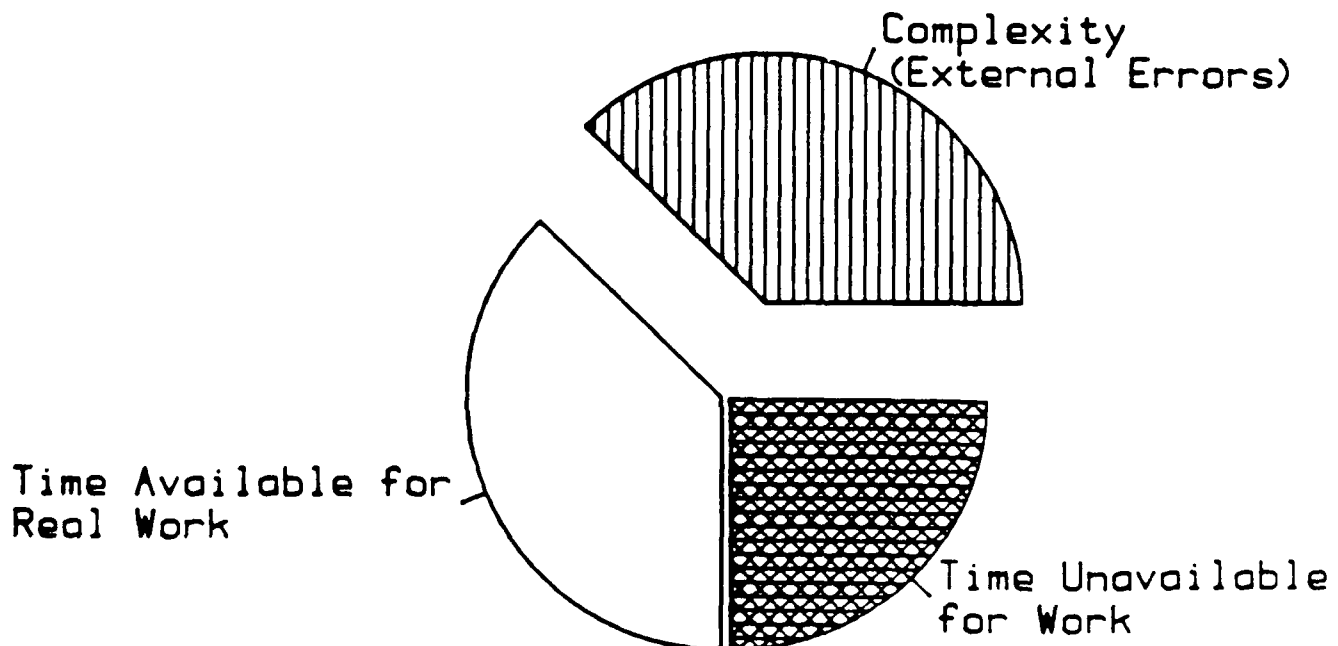


Table 1
Examples of Real Work and Externally
Induced Complexity
In Five Departments

Department	Complexity	Real Work
Accounting	Collecting overdue accounts resulting from carrier delivery problems	Mailing invoices
Production	Rework of faulty incoming materials	Assembly
Marketing	Handling customer complaints about poor quality materials	Helping customers buy
R&D	Redesign due to market research error	Asking customers about their needs
Personnel	Handling a lawsuit from employee who was mistreated in manufacturing	Training new managers

So we can expect a number of errors while people are doing real work.

Some of these errors are mistakes in carrying out the steps in the process, while others are problems with tools, supplies, equipment, and other items associated with the process. We might say that the real work activities are made up of "subactivities," some of which are complexity caused by errors within the process. By breaking up activities into very small parts and adding up those that are rework for internal errors, we might estimate that as much as 75 percent of the real work is complexity. In Figure 5 the shaded area of the circle has again been increased, this time to account for the subactivities devoted to fixing internal problems. Now less than 10 percent of people's time is available for real work.

Following are some subactivities categorized as complexity or real work:

Activity: Training new managers (Personnel).

Subactivities: Reserving a conference room (real work).

Resolving a meeting room conflict caused by a mistake in scheduling (complexity).

Leading a group discussion (real work).

Having a discussion about why the handouts can't be read because of copy machine problems (complexity).

Watching a videotaped lecture (real work).

Waiting for all the participants to arrive so the meeting can start (complexity).

Again, by visualizing the perfect process, one can sort these subactivities into two categories: real work (subactivities that would be required even if everything were to run perfectly) and complexity (subactivities that could be eliminated if the process were to run perfectly every time). It might follow that if one could break the subactivities into even smaller pieces, one could repeat the analysis and could categorize more activities as complexity at each iteration. Again, it appears that there truly may not be very much work in anything.

How to measure complexity

To decide where to start the quality and productivity improvement process, it helps to have some idea of the relative amounts of complexity in various parts of one's organization. The more complexity in an area, the more quickly and easily significant improvements can be made.

Often, one can make a rough estimate of the level of complexity in an operation by just walking around the work area and making visual observations of certain conditions. Seven conditions indicating a high level of complexity, and seven corresponding conditions indicating a low level, are listed below:

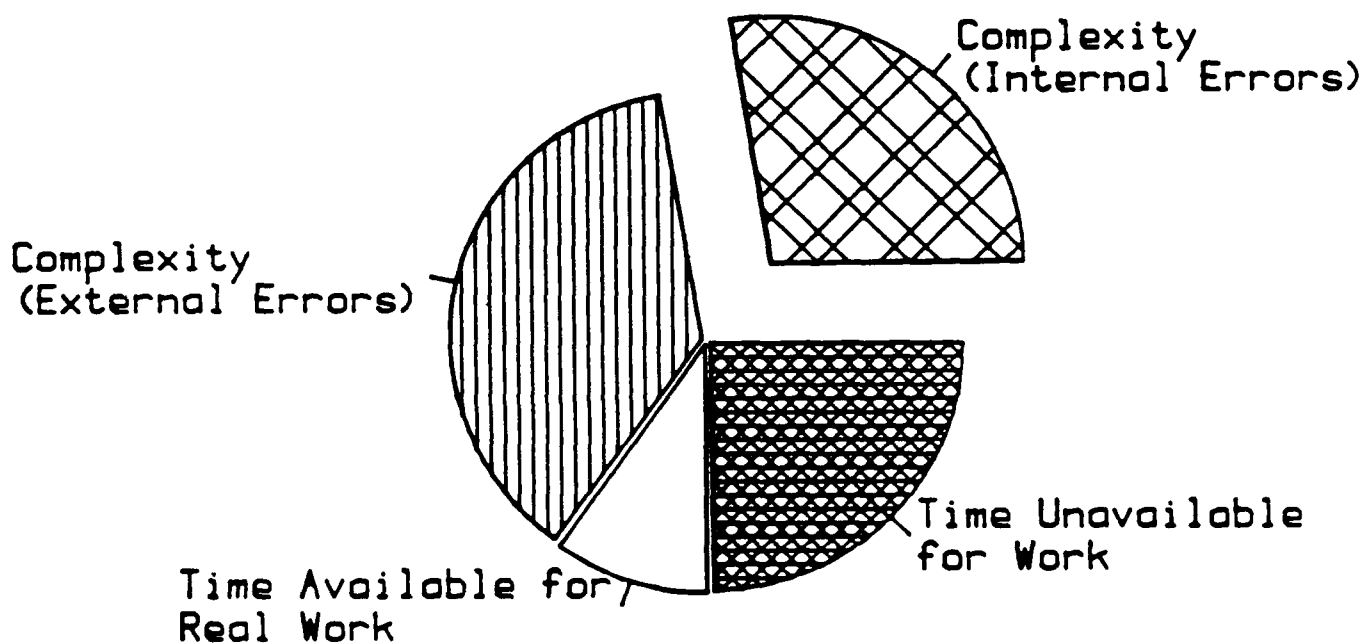
Indicators of high complexity:

1. Lots of work-in-process materials. Many shelves in the work area to hold material.
2. Many people walking from place to place, standing in a line waiting for something, standing idle.
3. Work areas that are in disarray. Dusty boxes on the floors, bookcases full of dusty binders, and desks and

Figure 5

COMPLEXITY MODEL

Amount of Time Lost Due to Internal Errors



walls covered with little scraps of paper serving as reminder notes.

4. People who can give only a brief, vague explanation of what they are working on and why it is important.

5. Humorous signs taped to the walls that say things like, "You want it when? Ha! Ha!" or "A clean desk is a sign of a sick mind."

6. In office areas, piles of processed and unprocessed documents stored in the work area.

7. Supervisors and managers pacing around the area trying to find out what's going on, ascertain who made a critical mistake, and expedite late orders.

Indicators of low complexity:

1. A small amount of work-in-process material. Few shelves in the work area to hold material.

2. Few people walking around carrying materials. Most people working at a steady, relaxed pace. No

one waiting in line at copy machines, office supplies, stores.

3. Work areas that are neat. Everything in a department has a place and a use. People using time management systems instead of scraps of paper. Desk tops containing only what the person is working on at the time.

4. People on the production floor or in an office area who can give complete descriptions of what they do, why they do it, who their customers are, and what's important to those customers.

5. The most common item displayed on department walls are monthly performance graphs, daily control charts of defects, Pareto charts of defects and problems.

6. In office areas all documents are received, processed, and filed. In baskets are clean.

7. Supervisors and managers who are relaxed, walking around the area talking with employees, asking

Simple work sampling can be used to make a good estimate of activities that are being performed because of errors.

them what they are working on, and looking for ways to make their employees' jobs easier and more satisfying.

After looking at these items, a manager should have an idea of the overall level of complexity. However, it may be more difficult to accurately categorize activities as real work or complexity and measure them. Simple work sampling can be used to make a good estimate of activities that are being performed because of errors introduced from outside the process and subactivities that are part of internal process complexity.

How to perform work sampling

The advent of cheap, multifunction electronic watches has made work sampling simple and easy for almost anyone to do. The basic idea is to look periodically at what a person is doing so that a list of activities can be developed and the relative frequency of each measured. If we ignore non-work-related activities, the list can be sorted into the two categories of real work and complexity due to *external* problems.

Then subactivities can be similarly grouped into real work and complexity related to *internal* process errors. When these data have been prepared, management can pull together interdepartmental task groups to eliminate the external errors. Work group improvement teams led by a supervisor can address the internal problems by solving the ones over which they have control and collecting data on the others so that management can take the proper action.

Work sampling process

Step I. Select the process to be studied. This may be determined from the data gathered previously by the department walk-through.

Step II. Procure a watch that has a "repeating countdown" function. This function allows setting a countdown timer to a particular number of minutes

and seconds. When the countdown feature is turned on, the watch counts down to zero, beeps one or more times, resets itself automatically, and begins the countdown again.

Step III. Determine the sampling procedure and the sample period. In some cases one may wish to look only at the activities of a single person. If so, the person will wear the watch, start the watch each morning, and turn it off at the end of the day. Each time the employee hears the beep, he or she is to immediately stop working and make several entries in his or her log or check sheet. The employee should record the time, place, activity, and subactivity.

This procedure will be most successful if a list of the major activities is determined in advance so that sorting will be easy. Determine the number of observations needed. In general, the more activities that a person might be doing, the more observations are required to obtain a true picture of what the person is working on. In most cases 100 should be enough for one person. A larger department may require several hundred observations spread over many people during an interval of such length that weekly and monthly activities can be recorded.

It is important that the beep of the watch be a surprise to the work sampling subject. If the employee anticipates the beep, he or she is likely to modify his or her behavior in some way that will distort the data. Ideally, the turning on and turning off times of the watch should be random. But since few watches have the capability to generate random beeps, the countdown timer should be set at an interval long enough and odd enough so the individual will be surprised when it beeps. Good results have been obtained with settings of twenty-three, forty-one, and forty-seven minutes but not with sixty minutes.

No matter what the setting, subjects are bound to change their behavior to some degree because of the study. However, this is potentially beneficial if the person is permanently imbued with an interest in studying the activities being performed.

Step IV. Train the worker. The work sampling process can be quite threatening to a person who does not understand how the data are to be used. The following points should be made clear to the person at the outset of the project:

1. The data should be used by the person

The complexity model can be used to detect quality problems in clerical-related as well as manufacturing-related processes.

doing the work to make improvements in his or her own process where he or she has control of it. For instance, the worker can control his or her personal business. The worker may also be able to improve the way work is done, within limits. He or she will be rewarded for helping in the project, especially if improvement suggestions are made.

2. The data will be used by management to look for system-type errors, either internal or external, and to eliminate them from the system. This will make the worker's job easier so that more of his or her time can be allocated to more productive activities.

Step V. Start taking observations. Visit with the worker after a few hours to make sure that he or she understands how to set and control the watch and that the watch is functioning properly. Check to see that the data are being recorded in the proper format.

Step VI. Analyze the data. After the required number of observations have been recorded, summarize the data. Some of the activities will fall into the unsanctioned personal time category and should be grouped separately. The issue of unsanctioned personal time is a highly sensitive area for the employee and should be handled carefully—management must take care not to criticize the person's use of time in order to encourage accurate data reporting. If the worker has any control, seeing the sorted data is usually good motivation to make changes for improvements in the use of time.

Now go through the list of activities. Decide for each activity whether it belongs in the category of real work or complexity due to external problems. Put together a Pareto chart for the top ten activities with an annotation on each bar showing the category.

Sort the sub-activities within the real work category, determining for each subactivity whether it is real work or complexity due to internal errors.

The manager should now have an excellent understanding of the amount of complexity in the department and the potential for improvement. He or she should also have an excellent understanding of the types and effects of errors from inside and outside the process. This exercise will usually motivate the manager to make a number of obvious improvements shortly after seeing the data. More data collection and tracking of process variables can be started to begin removing the causes of the more subtle errors.

Two case examples

The complexity model can be used to detect quality problems in clerical-related as well as manufacturing-related processes. Below, case examples are provided of the application of the model in a sales office and an order processing function. The data collection techniques differ in some ways from those proposed above, but in fundamental respects they follow our methodology.

Marketing associates in a sales office

Approximately thirty clerical and professional people worked in a Hewlett-Packard office taking orders for the company's products over the telephone. Management felt that a large amount of the work being performed was related to resolving problems caused by mistakes in processing and shipping the orders. It was decided that a study of the people's activities should take place so that management could have a better idea where the major problems were. Then, action could be taken to reduce them.

The work sampling plan was set up as follows:

1. The supervisor would wear the sampling watch.

2. When the watch beeped once every forty-two minutes, the supervisor would walk around a group of about ten people and ask each one what activity he or she was currently performing. Out of area or nonwork activities would be excluded from the study. If an employee was away from his or her desk when the supervisor came to collect data, no entry would be made for that person.

3. The study would cover a three-day period.

After three days of collecting data, the supervisor had a notebook containing 130 observations of the activities of 10 people. The date, time, and activity were recorded. Subactivities were not recorded.

The activities were then grouped by major category and counted. No attempt was made to determine whether the cause of any problem-related activities was internal to the group or external. However, the

data suggested that most problems were caused by activities of people outside the department.

The data were then grouped and sorted by frequency. The supervisor was asked the following question about each activity: "If there were no errors in the process and everything were running perfectly, would you be working on this activity?" If the answer was "no," that activity was categorized as complexity. If the answer was "yes," that activity was categorized as real work.

The real work and complexity activities were then counted and compared. Figure 6 shows the relative size of the two categories of work according to the number of activities in each category. The data

showed that the supervisor classified 42 of 120 observations as real work and 78 as complexity.

Figure 7 shows the relative frequency of the seven most likely activities that were being performed by the marketing associates. The seven activities, in descending order of frequency, were:

1. Processing customer returns (complexity).
2. Entering orders into the computer system (real work).
3. Converting orders to fix a problem (complexity).
4. Making changes to orders (real work).
5. Expediting shipments (complexity).

Figure 6

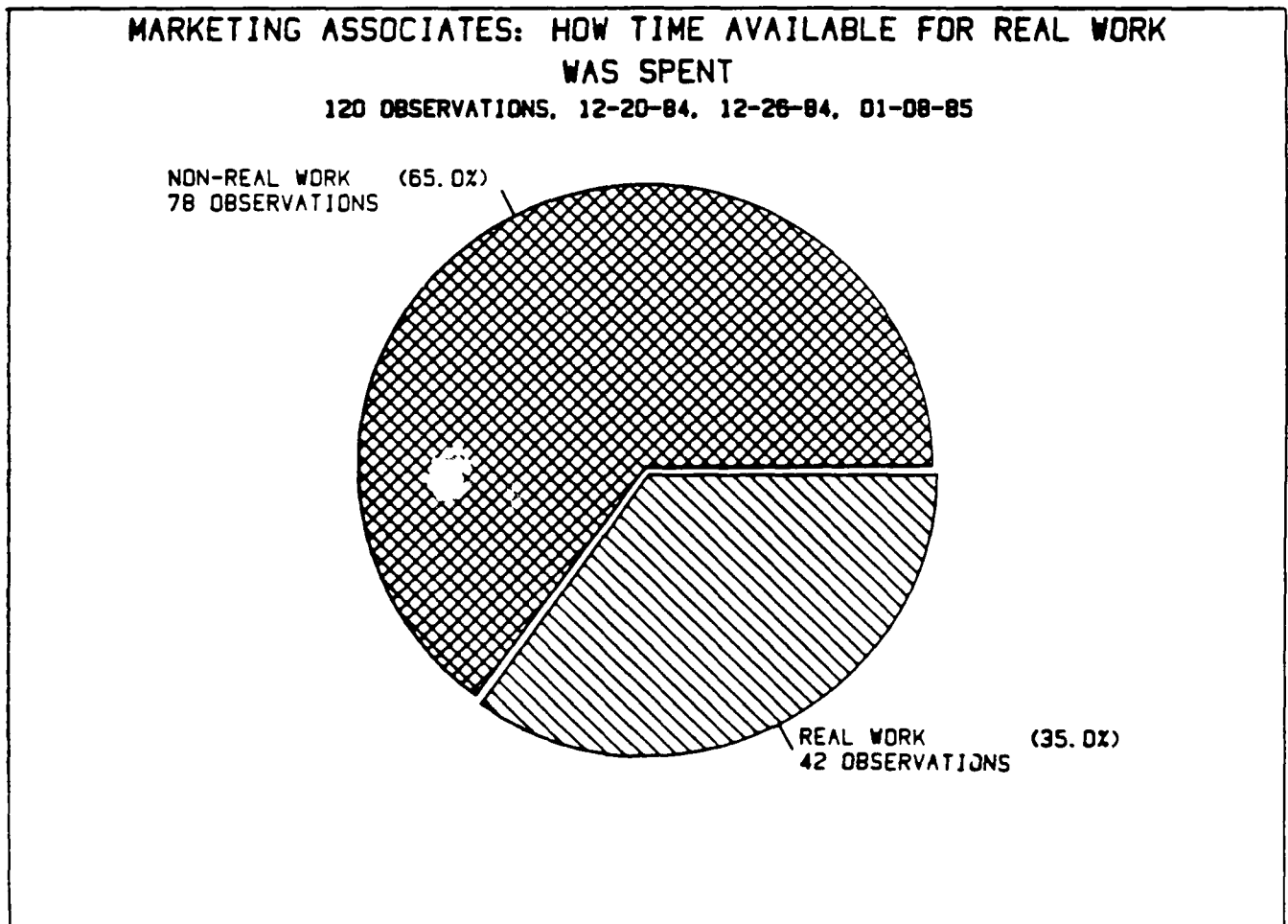
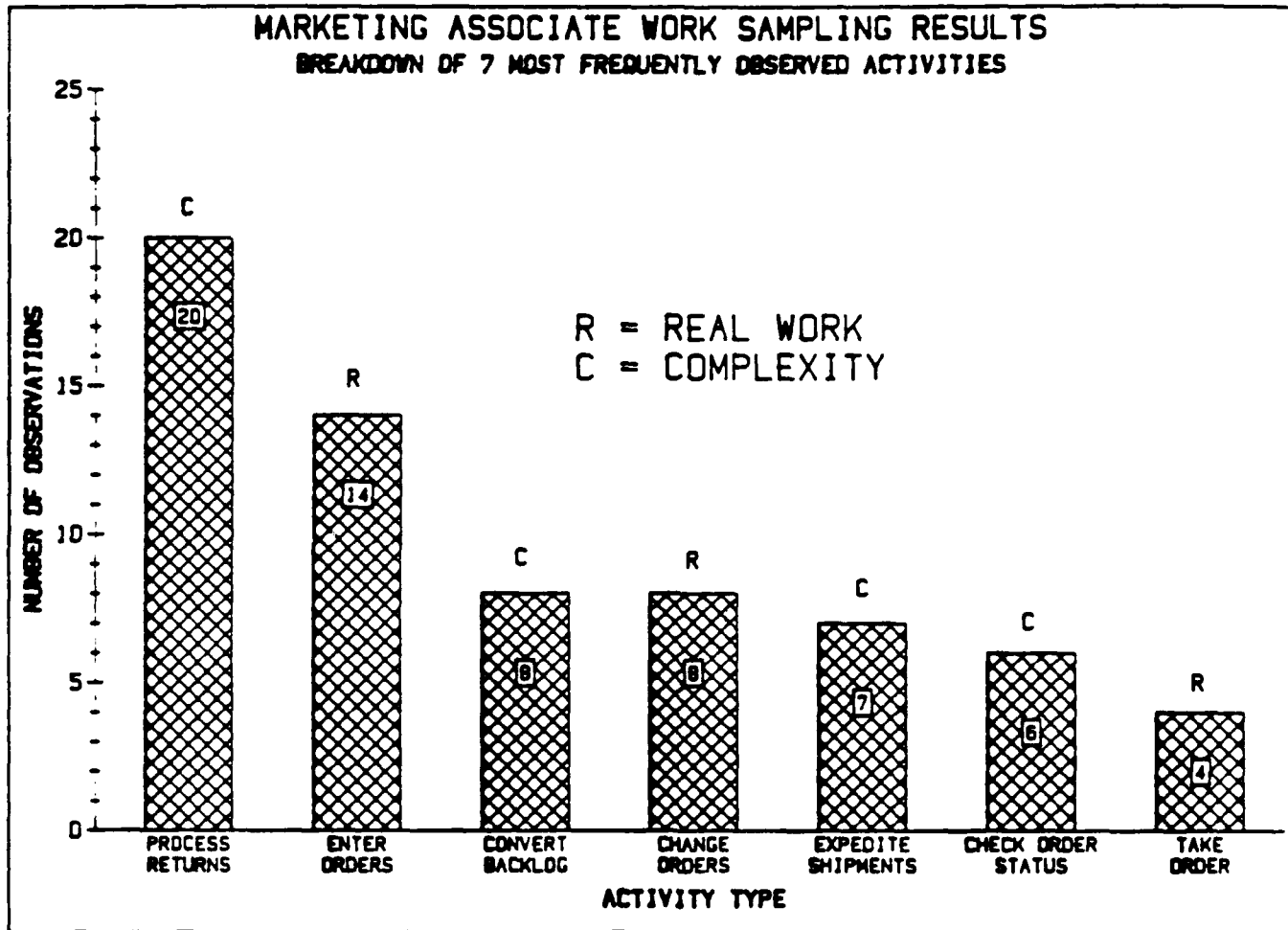


Figure 7



6. Answering questions from customers about the status of orders (complexity).
7. Taking orders over the telephone (real work).

Three of the seven most frequent activities were judged to be part of the standard process of taking orders and therefore were classified as real work. The most frequent activity was processing merchandise that was being returned by customers. The reasons given by customers included wrong product, duplicate shipment, and wrong quantity. This activity was categorized as complexity.

Upon seeing the data, the supervisor had several reactions. One was that "15 percent of the time my people are processing customer returns. This is equivalent to six people. This is far too many, and we need to first streamline the way we process returns and then see what we can do to eliminate them." Immediately, the supervisor made changes in the work procedures to improve the processing of returns. The supervisor felt that seeing the data sorted in the form of a Pareto chart helped motivate her to make the change. At the same time, a task force was formed to reduce the number of products returned. One person from each department that could ameliorate the problem joined this team.

Employees processing orders in a factory

The second case example concerns a group of clerical and professional people working in a Hewlett-Packard factory processing orders received from the sales office. Some people entered orders into the computer system, some matched orders with available products, and others shipped and invoiced the orders.

Management believed that a great deal of the work time was being spent fixing problems. It was felt that, as a result, employees were working a substantial amount of overtime and that morale was going

down because people could see no end to the heavy work load. Management decided to study the activities of the people to see if the situation could be improved.

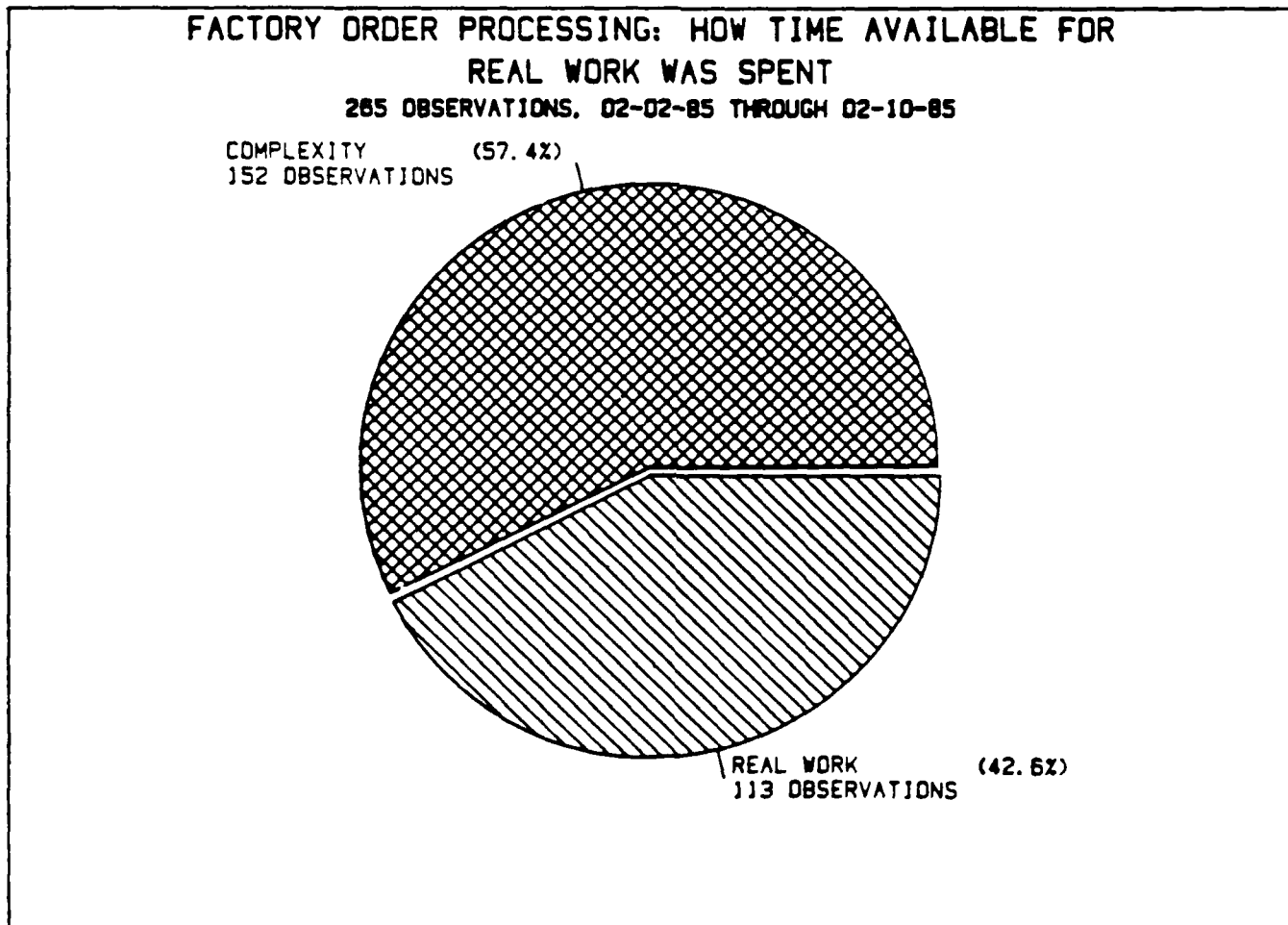
A work sampling study was set up with the following rules:

1. The supervisor would wear the watch, which would be set to beep every forty-one minutes. If the supervisor was to be out of the area, some other member of the department would wear the watch.

2. At the beep the person with the watch would roll a twenty-sided die to select three workers to be observed.

3. The person with the watch would ask each of the three people selected what they were working

Figure 8



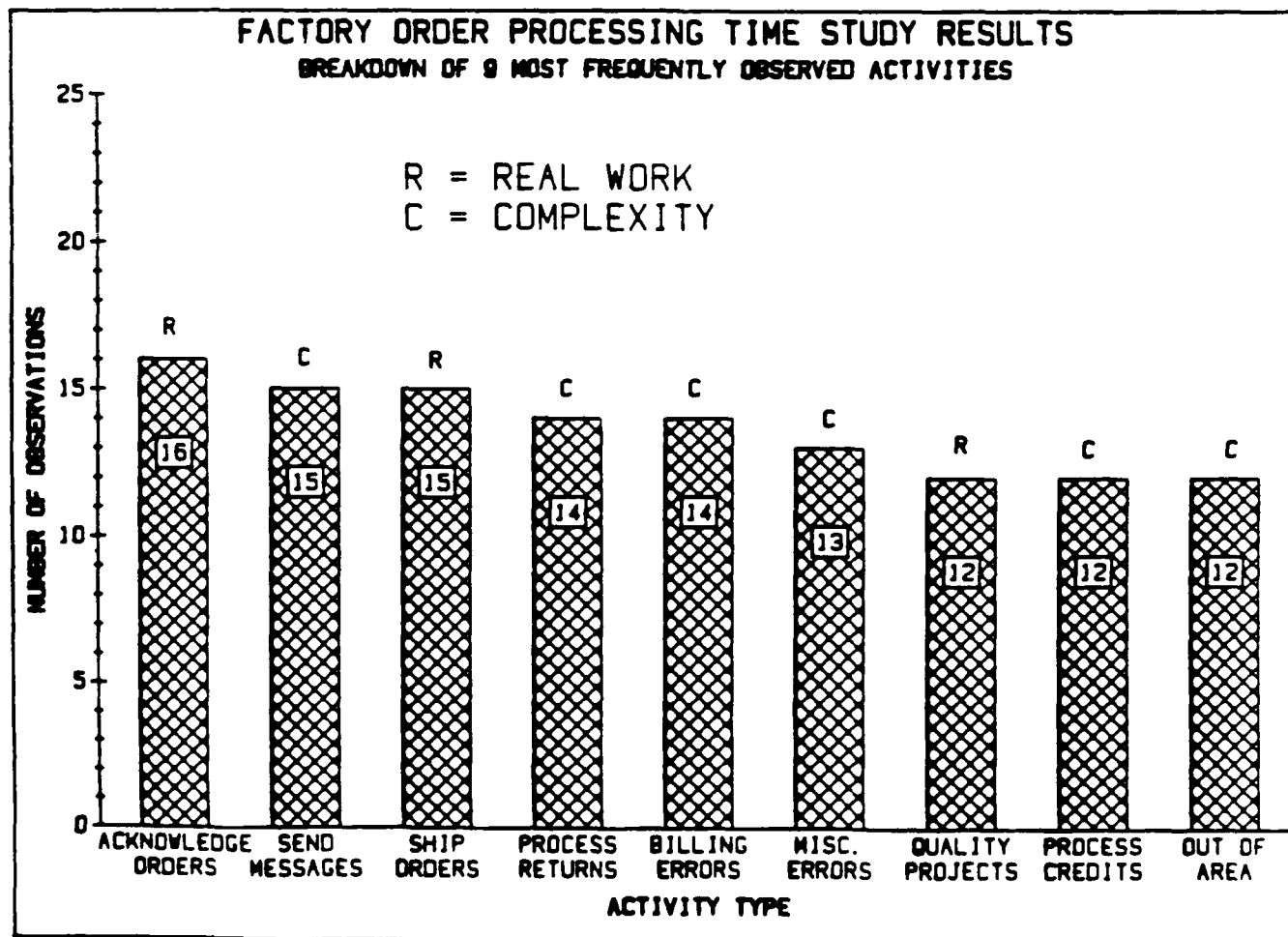
on at the moment. If any of the selected employees was out of the area, a note would be made of this fact. Upon returning, the employee was to be asked where he or she had been and what activity he or she had been engaged in. If the person was not working that day, no data were to be recorded.

Work sampling was carried out over a period of six days. During that time, 265 observations were made and recorded. The activities were grouped, counted, and classified in the same manner as in the previous case example. Figure 8 shows the division of the activities into real work and complexity. Of the 265 activities, 113 were classified as real work and 152 as complexity.

Figure 9 shows the nine activities that were observed most frequently. The activities, in descending order of frequency, were as follows:

1. Acknowledging order ship dates to customers (real work).
2. Sending messages through electronic mail (complexity).
3. Making computer entries to ship products (real work).
4. Processing customer returns (complexity).
5. Resolving billing mismatches (complexity).
6. Working on miscellaneous problems (complexity).

Figure 9



Six of the nine most frequently observed activities in order processing were classed as complexity.

7. Working on quality improvement projects such as preparing graphs or training (real work).
8. Processing credits for goods returned or to correct other problems (complexity).
9. Out of area, miscellaneous problems (complexity).

"Sending messages" was classified as complexity because the purpose of most messages was to explain problems or order status and because most messages were the result of errors in the process. Six of the nine most frequent activities were classed as complexity.

The data generated from this study confirmed management's belief that the people in the order processing department were spending a large portion of their time recovering from problems. A study was done to find the reasons for the large number of messages that were sent each day, and it was found that most were requests for status on orders. A project was begun to reduce order turnaround to improve customer satisfaction and to reduce the need to send messages asking for order status. Other projects were started to study the causes of the large number of customer returns and billing errors.

Conclusion

With experience in productivity improvement efforts comes increasing awareness that the bulk of the work we do in most large organizations is devoted to fixing problems. The data presented here suggest that far more than half of an employee's day may be spent either away from the work place or in the work

place performing tasks that would be unnecessary if the quality of materials, tools, equipment, and other process variables were improved.

Elimination of errors in factory and clerical processes can have a dramatic impact on raising worker productivity, often at little cost, as was shown in the example of back-order kit parts.

The complexity model may be applicable to other business processes, as indicated by the case examples. One need only look carefully at the activities that are performed to see that many of the tasks we carry out can be eliminated if we improve the quality of the processes of which they are a part.

Only management can make the process changes that can reduce the complexity in its organizations. Collecting and showing management work sampling data based on the complexity model can help motivate them to take needed action.

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The following Hewlett-Packard employees have provided the author help and encouragement: Will Carleton, Pat Dupray, Dr. Spencer Graves, Chet Harmer, Kathy Larson, Connie McIntire, and Nancie Plumb. Special thanks are also due to Dr. Perry Gluckman and W. P. Fuller, Jr.

Moen, R. D., & Nolan, T. W. (September 1987). Process improvement: A step-by-step approach to analyzing and improving a process. Quality Progress, 20(9), 62-68.

This article provides an outstanding overview of the process of improving systems and processes throughout the organization.

The authors address many of the basic concepts and techniques for improvement of processes in any organizational environment: the definition of a process, the concepts of process stability and special and common cause variation, the prevention of defects through understanding processes and improving them, the importance and the role of teamwork, the Taguchi loss function, cause-and-effect diagrams (Ishikawa diagrams), and others.

The article provides an excellent discussion of the improvement cycle (also known as the Deming or Shewhart cycle), guidelines for selection of improvement projects, and tools and techniques for use in each stage of the improvement cycle.

Process Improvement

A step-by-step approach to
analyzing and improving a process

by
Ronald D. Moen and Thomas W. Nolan

Figure 1.
Areas of Quality Improvement Application
in the Evolution of a New Product

Department	Function
Marketing	Customer Need ↓ Product Idea
Research ↓ Engineering	Product Concept ↓ Product Development
Manufacturing Engineering	Production Development
↓ Manufacturing	↓ Product Manufacturing
↓ Sales/Service	↓ Customer Satisfaction

COMPETITIVE PRESSURES ARE causing many organizations to focus on ways to reduce costs and increase productivity. Because quality improvement is a key objective in meeting those needs, it has become an integral part of many organizations' business strategy. Improvement of product quality depends on:

- understanding customer needs.
- designing the product to meet those needs.
- the design of the production process.
- knowledge of the product and production process.

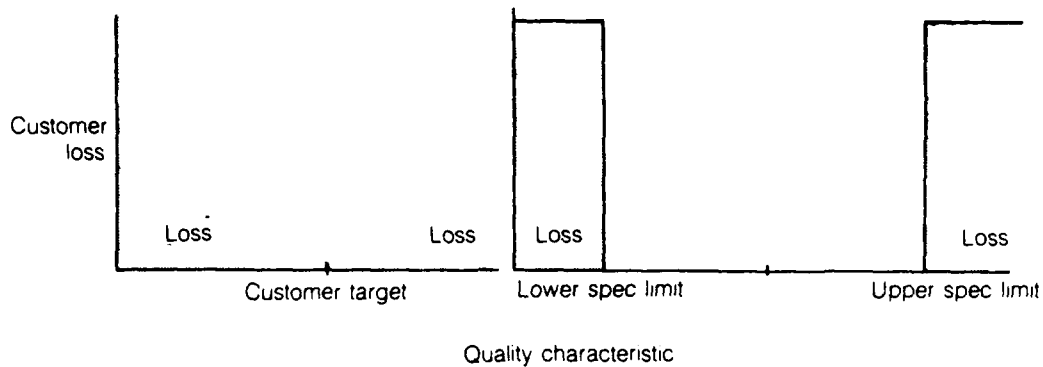
The responsibility for quality improvement in the evolution of a new product crosses many departments of an organization. The focus must be on identifying and improving the key processes in each function of each department. The key areas of involvement are shown in Figure 1.

The greatest benefits of improving quality will occur during the design of the product and of the manufacturing processes. The "leverage" for improvement during these phases is many times greater than improvements made downstream during manufacturing. The uncertainty of improving quality at these phases is increased since all test results must be extrapolated to determine how the product will perform in the future.

The requirements for quality improvement are a common purpose and a methodology for improvement. The underlying philosophy is continuous improvement in every process. Getting better and better is more important than whether the current status of the process is good or bad. Incremental improvements should be made on an ongoing basis.

One might ask, "Where do engineering specifications fit into this philosophy?" Specifications indicate the limit of acceptance or rejection of a product at inspection. They are necessary for communicating what is acceptable product, and they are goal oriented. However, in practice the approach of meeting specifications will not lend itself to continuous improvement.

Figure 2. Taguchi's loss function vs. specification loss function



Genichi Taguchi defines loss to the customer through a quadratic function that relates financial loss to the customer with distance from the target of the quality characteristic.¹ As the measurement of the characteristic moves away from the target, the loss increases (regardless of where the specs are). The traditional zero defects nature of being within specs would imply a loss function that is zero while inside the limits, and constant while outside the limits. Figure 2 illustrates the two interpretations of loss to the customer. The loss function on the left more accurately describes nature. Moreover, it provides the driving force for the philosophy of continuous improvement.

The key factor for success in improving quality will be people learning. Statistical methods will enhance the process of learning, as will an emphasis on teamwork. Only through a proper managerial environment, with every person working on improving quality to enhance customer satisfaction, will organizations be able to compete in the international marketplace.

Team activities should be centered on satisfying internal and external customers. Continuous communication and teamwork between customers and suppliers, and managers and those managed, will identify problems that should be attacked. This communication can be started with the following questions:

- Supplier to customer: What are some ways in which we could improve our product or service?
- Manager to those managed: What are some ways in which we could change the system so that you could do your job better?
- Customer to supplier: What changes could we make in our system to help you better meet our needs?

A management style must continually encourage these questions and allow people to work in teams to solve problems. Management must give teams the tools necessary to determine the underlying causes (not just symptoms) of problems and help the teams to eliminate them.

W. Edwards Deming's 14 points provide both a philosophy and a framework for making continuous quality improvement a focal point of an organization's business strategy.² Applying the 14 points represents a transformation of the management style present in many organizations today.

Process improvement

Historically, quality control in the manufacturing and service industries has consisted of inspecting the product or service against a set of requirements or specifications. In manufacturing this function is done by the quality control department. In service industries the counterpart of the QC department is often called the audit department. Once the product is inspected, it is sorted as either good or bad; bad product is reworked or scrapped. In service industries, rework would include things like resubmitting a computer run because of input errors, correcting errors on invoices in accounts payable, and delivering to a passenger's hotel a bag that had been incorrectly routed by an airline. There are several well-known inadequacies in this approach to quality improvement, among them:

- Quality issues are not addressed until it is too late. The product or service is already completed.
- Quality is obtained at high cost and loss of productivity.
- A "firefighting" approach to problem solving is adopted that results in short-term solutions to immediate problems at the expense of long-term improvement.

Moving to the prevention of defects requires work on the process that produces the product. This change in thinking is necessary to achieve a higher-quality product at a lower cost. Put simply, inspecting products achieves higher quality at higher cost, while improving the process achieves higher quality at lower cost. Improving the process increases the uniformity of the output. Lower cost is achieved by reducing rework, scrap, or complexity.

There are some major differences between inspecting products and improving the process. Analysis of the process is done by all members of the organization and thus becomes a small part of everybody's job, rather than the total responsibility of a few. The process is inspected, and hence learning takes place, even when no defective products or services are being produced. Quality is increased through the use of new knowledge as a basis for changing the process. Since these changes allow tasks to be done better, faster, and easier, decreases in cost accompany the improvements in quality.

Process model

What is a process? A process is defined as a set of causes and conditions that repeatedly come together to transform inputs into outcomes. The inputs may include people, methods, material, equipment, environment, and information. There can be several stages to the process, or each stage could be viewed as a process. The outcome is a product or service.

An example of a process might be the design of a product. The stages are: request for a design, preliminary design, review, and approval of design. Inputs include information from marketing as well as engineering knowledge. The outcome is a written description of a product design. Other examples of processes are injection molding, an assembly line operation, pressed metal stamping, the hiring process, classroom training, billing, or managing people.

The next question is, "What is meant by process improvement?" Process improvement is the continuous endeavor to learn about the cause-and-effect mechanisms in a process to change the process to reduce variation and complexity and improve customer satisfaction. Improvements are made through actions that are based on a better understanding of the cause system that affects process performance.

Basic sources for process improvement

Performance indicators (quality characteristics) can be identified and measured for most processes. For manufacturing processes, measures include such things as length, width, viscosity, color, temperature, line speed, number of accidents, and percent rejected material. Number of errors in billing, number of incorrect transactions in a bank, check-out time in a grocery store, frequency of program restarts in data processing, and actual expenditures are examples of performance measures for service processes. All of these measures will vary over time. Analysis of this variation is used as a basis of action to improve the process. However, this action is often inappropriate or counterproductive, because people don't understand the concept of common and special causes of variation.

A basic concept introduced by Walter Shewhart for the study and improvement of processes is that variation in the outcome of a process is due to two types of causes. Common causes are those that are inherent in the process hour

after hour, day after day, and that affect everyone working in the process. Special causes are those that are not in the process all the time or do not affect everyone, but arise because of special circumstances. For example, the attentiveness of 50 people at a presentation is affected by causes common to all of them such as room temperature and lighting, the speaker's style, and the subject matter. There are also causes that affect the attentiveness of individuals, such as lack of sleep, family problems, and health. These causes arise because of special circumstances.

A stable process is one in which variation in outcomes arises only from common causes. A stable process is in a state of statistical control. The cause system remains essentially constant over time. This does not mean that there is no variation in the outcome, that the variation is small, or that the outcomes meet customer requirements. A stable process implies only that the variation is predictable within statistically established bounds.

An unstable process is defined as one in which outcomes are affected by both common and special causes. An unstable process does not necessarily have large variation. It means that the magnitude of the variation from one time period to the next is unpredictable.

As special causes are identified and removed, a process becomes stable. Deming gives several benefits of a stable process, including:²

- The process has an identity; its performance is predictable.
- Costs are predictable.
- Regularity of output is an important byproduct of a stable process. (The just-in-time system of parts delivery follows naturally.)
- Productivity is at a maximum and costs at a minimum under the present system.
- The effect of changes in the process can be measured quickly and reliably. In an unstable process it is hard to separate changes in the process from special causes, and therefore it's harder to know whether a change results in improvement.

It is vital to know when an adjustment of the process will improve performance. Adjustment of a stable process, that is, one whose output is dominated by common causes, will increase variation. This overadjustment or tampering with a stable system is common in both manufacturing and management processes. Improvement of a stable process is achieved only through a fundamental change in the proc-

Figure 3.

Flow chart for sources of improvement

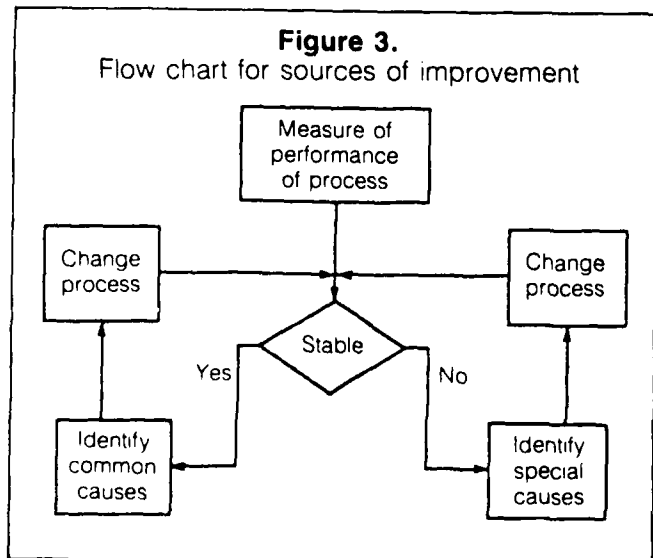


Figure 4.

Supplier/customer relationship for process improvement

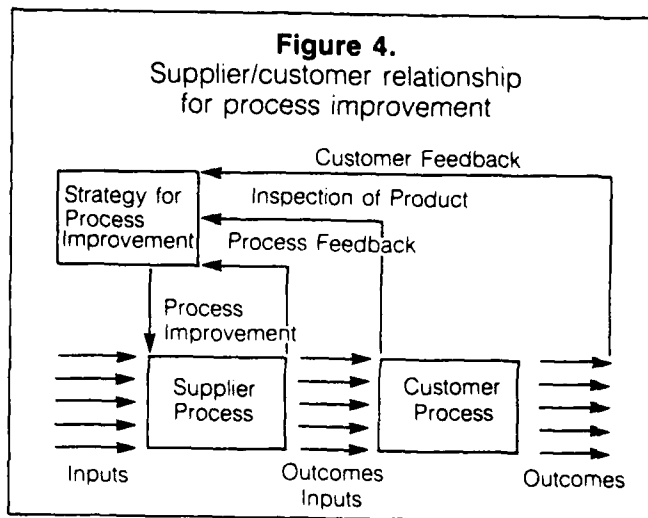
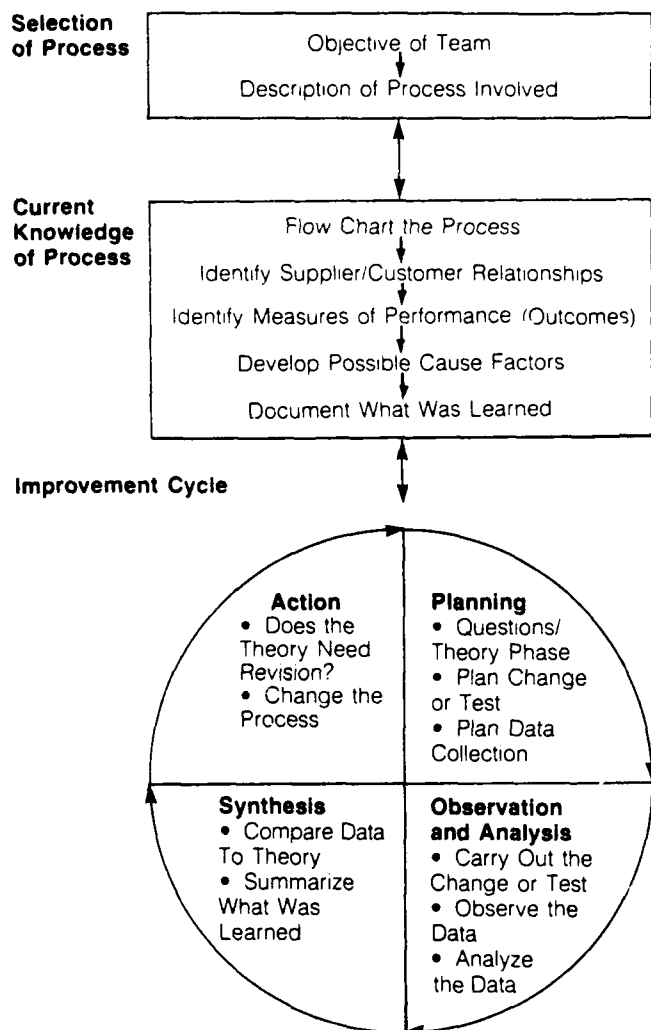


Figure 5.
Strategy for process improvement



ess that results in the removal of some of the common causes.

One of the first steps in improving any process is to learn whether the process is dominated by common causes or special causes. The tool to use is the Shewhart control chart. The people that can identify special causes are usually different from those needed to identify common causes. The same is true of those needed to remove common causes. Removal of common causes is the responsibility of management, with the aid of experts like engineers and chemists. Identification of special causes can usually be handled at a local level by those working in the process using control charting. Removal of special causes is the responsibility of immediate supervision.

Once the process has been brought to a stable state, its capability or performance in the future is predictable. This range of variation is compared to customer requirements to determine if the process can meet those requirements.

The flow chart in Figure 3 provides an outline of the steps in the separation of causes as a basis for improvement. No improvement will be made without a change in the process.

Strategy for process improvement

Process improvement is aided by viewing an organization as a network of linkages of processes run by internal producers of output and internal customers of this output. The ultimate output of this network is the product or service provided to an external customer. Quality and productivity are improved as producers work in teams with their suppliers (internal and external) to improve internal customer satisfaction and hence external customer satisfaction. This supplier/customer relationship is illustrated in Figure 4.

Suppliers' targets serve as surrogates for customer needs. Each customer becomes the supplier for subsequent needs. This repeats until the product or service reaches the final customer.³

There traditionally are two feedback loops that provide a basis for action. The customer feedback loop is too late—the product (or service) has already been produced. The second feedback loop is inspection according to specifications, the inadequacies of which have already been discussed. Deming describes action based on these two feedback loops as "retroactive" management.⁴ The principal basis for action for the supplier is the data from the most timely feedback loop in the process. The objective is improve the process. The other two loops will serve as measurements to evaluate the progress.

The strategy for process improvement involves three major activities: 1) selecting the process, 2) documenting the current knowledge of the process, and 3) using an improvement cycle to increase the knowledge of the process (Figure 5).

Selecting the process

The first activity involves identifying the process that would have the greatest effect on improving customer satisfaction. This could be the result of a simple question to the customer—"What are some ways we could improve our product or service?"—or the result of customer feedback through a survey.

The team chosen to work on improving this process should include people working in the process, people in authority to change the process, upstream suppliers, downstream customers, and related experts. The team must start off with a clear statement of the objective they hope to achieve. Each member of the team should see the accomplishment of this objective as very important. Next, the team creates a description of the initial process. This documentation should identify the inputs and outcomes of the process.

This activity begins with the creation of a flow chart that documents the important stages in the process. Relationships between the supplier and customer are identified in each

stage. Next, identify output measures of performance for each stage. Some questions concerning the measures of performance might be:

- Is the measure of performance well defined?
- Has the variation of measurement been quantified?
- Has the measure of performance been stable?

Now, draw a cause-and-effect diagram for each measure to be studied. The last step is documenting the current knowledge of the process. This documentation grows as more is learned about the process during the improvement cycle.

Improvement cycle

The last activity is the iterative use of the improvement cycle. Using this cycle, which is an adaptation of the scientific method, will increase users' knowledge of the process. Variations of this cycle have been called the Shewhart Cycle, Deming Cycle, and plan-do-check act (or P-D-C-A) Cycle. The improvement cycle has four steps:

Step 1. Planning. Once a project has been selected, the theory phase of the planning step begins. Theory may range from a hunch or "gut feeling" to well-accepted scientific principles at various times throughout the cycle. Questions to be asked during the theory phase relate to current knowledge of the process, such as:

- What are the opportunities for improvement?
- What would be desirable process changes?
- What are some important sources of data?
- What are the most important causes of process variation?

The next phase is to plan the collection of some type of data. The data will be used to increase knowledge of the process and will help establish a consensus among team members. The questions to be answered by the data will guide the data collection process.

Step 2. Observation and analysis. The observation phase begins when the plan for collecting data is put in place. The data should be observed as soon as they become available. Any data collection process has many opportunities for error and many opportunities for special causes to occur. Plotting the data chronologically as they are obtained is vital for recognizing problems.

Once the data are obtained, they are analyzed to help answer the questions posed in the theory phase. In preparing for this analysis the team should determine the resources needed. Most data from well-planned studies can be analyzed using simple graphical methods, but there may be occasions when computers are needed. Most teams should be able to analyze their own data, but there will be times when help from a statistician or other expert is needed.

Step 3. Synthesis. This phase brings together the results of the data analysis and the existing knowledge of the process. The theory is modified if the data contradict certain beliefs about the process. If the data confirm the existing theory about the process, then the team will be confident that the theory provides sufficient basis for action on the process.

Step 4. Action. Do we make a change in the process or go through the cycle without making a change? If a change is made, will it affect people? What other impact would a change in the process have?

If the data were collected to increase the knowledge of the cause-and-effect relationships in the process, then the team should determine whether it has enough assurance that the present theory forms a basis for a change in the process. If not, the cycle is begun again. Otherwise, a change

is made on as small a scale as possible. Then the cycle is begun again to check the results of the change.

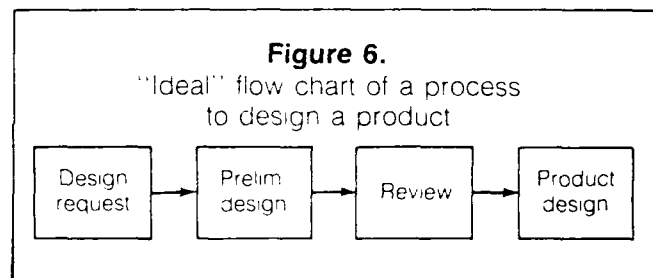
If the data were collected to evaluate a change in the process, the analysis should determine whether the change brought about the expected improvement. If it has, the team should consider under what conditions the results might be different and list them for future study. If the data do not indicate the expected improvement, the team should answer two questions:

- Do we sufficiently understand the cause-and-effect relationship?
- If the cause-and-effect theory is correct, what different process change is needed?

The answers to these questions become the basis for a new loop through the cycle. Among the important attributes of the cycle are:

- Planning is based on theory.
- The same people that plan a change carry it out.
- It provides focus and discipline to team.
- It provides a framework for the application of statistical methods.
- It encourages repeated use of the cycle.
- It enhances the iterative learning process.
- It requires documenting of what was learned.

There is no unique route to problem solving. Convergence by repeated use of the cycle is what is important. The greater the learning, the faster the convergence.



Methodology for defining current knowledge

The process improvement strategy involves the use of various methods that enhance learning about the process, including flow charts, measures of performance, cause-and-effect diagrams, and the improvement cycle for current knowledge.

Flow chart. The first step in documenting current knowledge of the process is drawing a flow chart of the process. A flow chart displays the various stages in the process, and, by the use of different types of symbols, demonstrates the flow of product or service over time. Flow charts are used for:

- a visual display of a process.
- process documentation of current knowledge.
- identifying problem areas and complexity.
- stimulating ideas for process improvement.
- identifying data gathering areas.
- training and communication.

The hardest step in drawing a flow chart is deciding how many tasks or operations and how much detail it should include. Usually people include too much detail or too many tasks in one flow chart. It may be best to start with the last stage involving the customer and work backward, including only enough detail to give an understanding of what is happening. The first flow chart might be an outline of major stages only. An "ideal" flow would be from one stage to the next with no complexity (Figure 6).

At each stage of Figure 6 the major obstacles in carrying out the tasks at that stage might be listed. What are the outcomes at each stage? What is measurable? With the help of people working in the process, draw the actual process in use. Redundant stages or patching of systems may be revealed. Major obstacles may be identified. The actual process may look more like Figure 7.

Measures of performance. Once the team agrees on the flow of the process, the supplier/customer relationships are identified at each stage. What is the mechanism for customer feedback? What are the measures of performance of the outcomes for the supplier's process?

Identifying the basic measures of performance for the outcomes of each stage is an important step in documenting current knowledge of the process. These measures can be identified as "checking points" on the performance of the process as illustrated by the process flow chart. Examples of measures of performance for different types of processes are given in Figure 8. Many of these examples require operational definitions that will put communicable meaning into a concept.¹ For example, what is meant by failure time of product, outgoing quality, computer downtime, and wasted man-hours?

A test method provides a measure of performance. What is the "quality" of these measurements? We cannot directly assess the quality of an individual measurement. We can only evaluate a measurement in terms of what we know about the test method. The test method can be characterized in terms of precision, accuracy, bias, sensitivity, robustness, stability, reliability, cost, speed, and simplicity. There

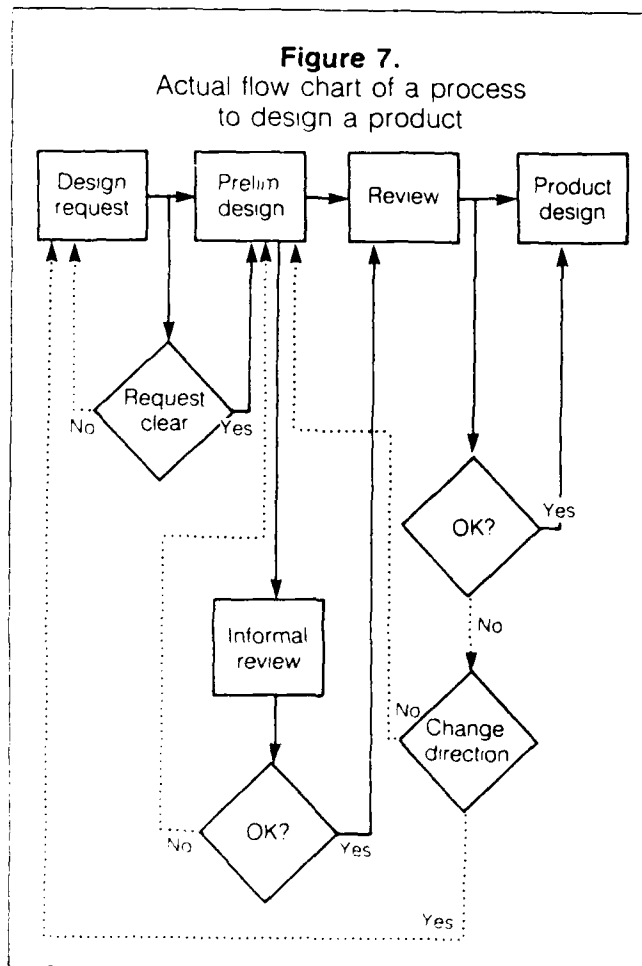


Figure 8.
Typical Measures of Process Performance
By Department or Function

Marketing Sales/Service

- Time to process engineering changes
- Error in filling out dealer orders
- Customer complaints
- Time of transit of parts to customers

Engineering

- Time to process engineering changes
- Number of requests
- Number of engineering design changes
- Failure time of product

Manufacturing

- Downtime
- Amount of scrap or rework
- Level of inventory
- Outgoing quality

Administrative

- Time to process travel expense reports
- Computer downtime
- Idle time of company vehicles
- Time filling orders from stockroom

Management

- Number of accidents; related time loss
- Percent of overtime
- Wasted man-hours due to the system
- Training and educating employees

is not a "true value" for any test method to compare, and the standard method is always subject to modification or obsolescence. The degree of accuracy a test method requires relates to how the results will be used.

The identification of a measure of performance is the window through which we can observe processes. If that window does not provide a predictable, consistent view of the process, intelligent decisions about actions to be taken on the process cannot be made.

Since a test method transforms inputs into outcomes, it is a process. This process must be stable, otherwise a method of measurement with predictable performance does not exist. Has the variation of measurement been quantified? The measurement process should be monitored with control charts as a routine part of the process control activities.

Cause-and-effect diagrams. One of the best methods for organizing all known causes of variation is with a cause-and-effect diagram. Developed by Kaoru Ishikawa, this diagram breaks the causes into general categories like methods, materials, machines, and man, and organizes them to illustrate the common relationships.

The cause-and-effect diagram's versatility makes it a useful tool for organizing problem solving efforts in every area of manufacturing and service industries. Its versatility lies in its design, while its power comes from the graphic representation of the relationships between problems and their sources.

Improvement cycle for current knowledge. The improvement cycle is used to increase our knowledge about a process. This cycle is actually a model for learning. A deduction (prediction) based on some theory is made, observation is taken (data collection), a comparison is made of the data to the predicted consequences, and a modification of the theory (learning) is made when the consequences and the data fail to agree. Deming says "Experience (by itself) teaches you

Figure 9.
Application of Methods
With the Improvement Cycle

Objective of Cycle	Most Common Method
Understanding the customer	Survey methods
Narrowing the focus of the process	Check sheet and Pareto analysis
Study of the measurement process	Control charts
Study of stability of process measures of performance	Control charts
Study cause-and-effect mechanisms in the process	Design of experiments
Plan a change in the process	Design of experiments
Evaluate change under different conditions	Design of experiments
Maintain new level	Control charts

nothing. You learn by subjecting experience to question. Questions come from theory."⁴

Knowledge is useless if it does not result in action. Did things get better? How would you know? These questions can be answered only through data collection. Many times a person has a preconceived notion of the course of action and searches for data to support the action. In such cases, no learning occurs, nor does any improvement in quality.

Methodology for use with the improvement cycle

The improvement cycle provides a systematic way of accomplishing change. Action must be taken to make a change. Will the action result in improved performance of the process in the future? What other knowledge is needed to take action on the process? A cycle is planned around one of two purposes:

1. Test to gain additional knowledge of the process; or
2. Evaluate the effect of a change in the process.

Planning a test of the process will help us understand the process. Will the data represent a stable process? Data must be plotted in order of production to answer the question. A more active approach is to deliberately change factors or conditions to determine their relationship to improving processes that have become stable. Do we need to modify our cause-and-effect theory? Have we increased our knowledge for prediction of the results of future experiments? Should we change the process and begin a new cycle to evaluate the change?

Evaluating a change in the process will start us off on the road to process improvement. Did process performance improve? Why or why not? Under what conditions might the results be different? What will be the impact downstream in the process? Should we begin a new cycle by testing a new condition? Confirmation of observed improvements over time may be necessary.

The plan for a cycle must include the methods to be used for collecting and analyzing data. Methods to consider include check sheets, histograms, Pareto diagrams, design of experiments, scatter diagrams, survey methods, run-order

plots, simulation/modeling, control charts, and engineering analysis. The choice of method depends on the objective of the cycle. Figure 9 provides a general guideline for applying various methods. The order of the cycle objectives will differ depending on the project. However, the order shown in Figure 9 is typical of the order in cycles performed on many projects.

A roadmap for improvement

Improving product or service quality is achieved through improvements in the processes that produce the product or service. Every activity and every job is part of a process—and can be improved. Improvement comes through people learning. The strategy for process improvement just presented provides a roadmap for that improvement. This roadmap includes a team with a common objective, selecting the related process, defining the current knowledge, and building on that knowledge to make a change in the process using the improvement cycle. Embedded in this cycle are methods that will enhance the learning process. Applications of this strategy include the evolution of a new product as well as existing products or services in marketing, engineering, manufacturing, and administrative, or management, areas.

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Ronald D. Moen is a partner in Associates in Process Improvement, a management and statistical consulting group. Moen has 21 years' experience as a teacher, manager, and consultant to government and industry. He has worked with W. Edwards Deming in implementing the Deming principles at Pontiac Motor Division (1981-1984) and has served as a helper to Deming at over 40 of his four-day seminars (1983-present). Moen holds an MS in mathematics and an MA in statistics from the University of Missouri. He has done additional graduate work at The George Washington University, the University of Minnesota, and Rutgers University. He is a member of ASQC and the American Statistical Association.

Thomas W. Nolan is a founding partner of Associates in Process Improvement. Previously, Nolan had 18 years of experience in government and industry as a statistician. He holds a PhD in statistics from The George Washington University and is a member of the American Statistical Association.

Hoffer, W. (April 1988). Errors on the job can be reduced. Nation's Business, 76(4), 62-64.

This article provides an interesting discussion of the human tendency to attribute mistakes to individuals rather than to the systems, processes, and environments that they work in. Several examples are cited. The author suggests that significant improvement can be achieved through the analysis of the process and situation that caused the error.

For such an analysis to be carried out and for improvement to take place, management must be forgiving, because employees are more likely to participate in such an analysis when they understand that its purpose is to improve the work environment, not to assign blame or punishment.

Errors On The Job Can Be Reduced

By William Hoffer

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A veteran commercial pilot inadvertently shuts down his jetliner's engines after takeoff, correcting his mistake just in time to prevent a crash.

A law firm employee doing paperwork on a \$93 million lien omits three zeros from the figure, recording it instead as \$93,000 and leaving the lienholder vulnerable to a \$92,907,000 loss.

A nuclear plant's control-room operators, trying to cope with a mechanical malfunction, turn off a cooling system during a period when it might have reduced the risk of radioactive material escaping from the plant.

Workplace errors such as these in recent years have spurred the efforts of some behavior researchers trying to determine just why capable people make mistakes on the job, and how such mistakes can be reduced. The approach of some of these researchers has been running counter to earlier strategies in dealing with workers' fallibility.

In the past, many businesses have attacked error by cajoling or threatening their employees to pay more attention to their tasks. Such efforts often took the form of a "zero-defects" campaign. But according to a current opinion in error research, that type of strategy is based upon two erroneous assumptions.

The first is the notion that all errors can be eliminated somehow. "Several studies indicate that errors occur randomly in time," says John W. Senders, resident professor of engineering and psychology at the University of Maine in Orono. "There really is no way to stop them from occurring."

Modern error analysis, therefore, seeks not to counteract or eliminate all errors—now seen as impossible—but rather to acknowledge the existence of error, prepare for it and minimize its consequences.

"Our emphasis is not to eliminate error, but to reduce the incidence of critical error," says Senders.

The second mistaken assumption about on-the-job errors is that they are necessarily the fault of the employees. Alan D. Swain, senior scientist at Argonne National Laboratory and a consultant based in Albuquerque, N.M., contends that most critical errors result

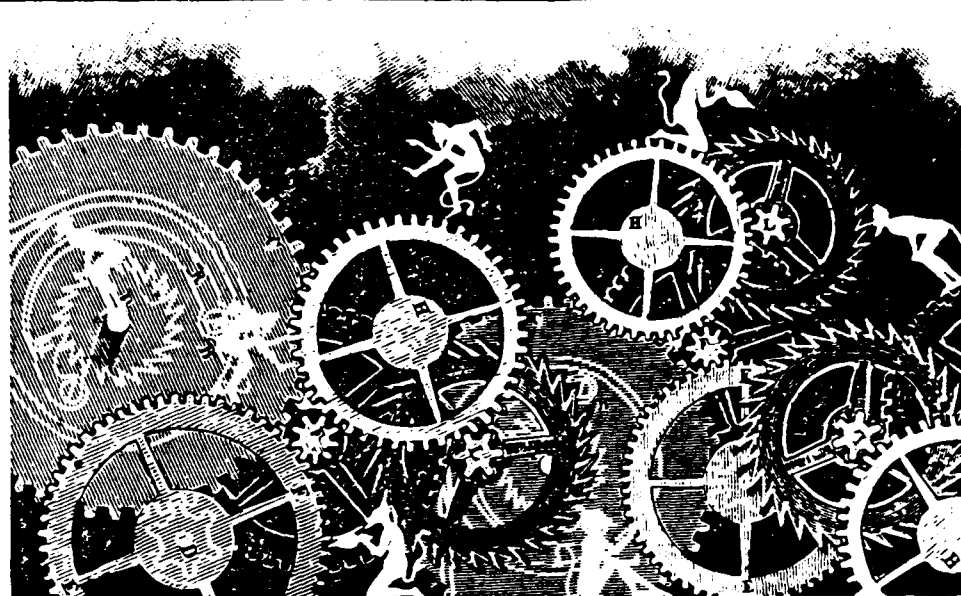


ILLUSTRATION: JOHN PACK

from faulty workplace design. And since it is management's responsibility to provide the workplace, management bears the responsibility for error, he maintains.

Swain categorizes workplace errors as either "situation-caused" or "human-caused." Analysis shows that situation-caused errors—those related to the design of the work environment—account for about 85 percent of workplace errors, and the rest are human-caused mistakes. Most errors, says Swain, should be seen "as the natural outgrowth of some unfavorable combination of people and work situation."

This was illustrated by what some error researchers informally call the "Gold Box Study." In a certain manufacturing plant, workers handling an expensive and breakable gold-plated component called the "gold box" often dropped the object. Though management accused the workers of carelessness and threatened punishment, the "gold boxes" continued to hit the floor at an alarming rate.

In desperation, management hired a consultant, a specialist in human-factors research, who took a simple if often-overlooked action: He watched the employees work. Management had told the consultant that each "gold box" was handled no more than 100 times during the production process. But the

researcher counted at least 1,000 opportunities for each "gold box" to be dropped. Though employees were being careful, they simply had too many chances to drop the component.

The consultant helped the manufacturer to redesign the assembly line so that the opportunities for error were reduced from 1,000 to under 100. The breakage rate dropped dramatically.

It has been known for some time that certain factors such as routine, fatigue, stress and distraction—notably noise—are associated with errors. Chief among these so-called error factors is routine—a finding that holds even for those whose job is to find errors. Swain says that inspectors—men and women who are supposed to spot other people's mistakes—generally fail to find 15 percent of all defective products. Since most products are not defective, the inspector becomes accustomed to seeing no defects.

Encountering this problem at a defense plant, Swain suggested that no one should be assigned to inspect for longer than a half hour at a time. This would assure that each inspector presumably would be more rested and vigilant. "This one change," he says, "was enough to reduce the number of defects getting by the inspectors."

Researchers now understand better how the error factors disrupt thought

While to err is human, your employees' errors might be lessened if you see their mistakes arising from typical causes such as routine, fatigue, stress, distraction, noise and workplace design.



processes. "I believe it foolhardy to attempt to determine the reason or cause of an incident," says Donald A. Norman, director of the Institute for Cognitive Science at the University of California in San Diego. "Many or most incidents are bound to have multiple causes," he says, and often it is found that the absence of any one of the causes would have prevented the incident.

Norman has spent years compiling examples of errors, such as the incident involving two sales clerks in a department store, standing side-by-side and each talking on the phone. In order to grab a sales form, one clerk moved behind the other, so the two women switched positions. When the first clerk completed her call, she placed her receiver on the other clerk's telephone, cutting off the other call and angering the customer. A quick solution: two telephones of different colors.

Norman says such foul-ups result from the brain's penchant for developing shortcuts to handle routine matters. When you leave home in the morning, for example, you don't say to yourself, "Now I'm going to start the car and back out of the driveway." Driving to the office is so routine that your brain does not concentrate on each step. You simply decide to drive to the office, and your brain sets into motion the familiar

courses of action that normally lead you to your desk. That is a subprogram developed by the brain, says Norman.

He calls it a schema and says it unconsciously takes care of routine business, letting the conscious mind concentrate on other matters. The process usually works, but it is subject to glitches.

Trouble may surface when you try to run competing schemas simultaneously. Suppose that while you are driving and listening to the car radio, you hear a news report of a scandal involving a company in which you own stock. Suddenly you have plugged in a second schema—for paying attention to the news. Your memory flashes back to your recent decision not to sell that stock. Self-doubt creeps in. Is your judgment slipping? Your concentration shifts, and your drive-to-the-office schema gets pushed farther away from consciousness. You are trying to run too many programs in your brain at the same time. You drive right past your regular freeway exit.

Sometimes the brain assesses the available data and plugs in the wrong schema because it associates with a particular stimulus.

Norman cites the example of a person counting "eight, nine, ten, Jack, Queen, King." The person had been playing cards recently and the familiar

schema captured the brain's attention.

Or the proper schema is activated but then "decays," such as when you walk into a room and wonder why you are there, or you lose your train of thought.

The most important concept of modern error research is that such foul-ups are normal. The human brain has a phenomenal ability to store information, but it also possesses a disconcerting capacity for departing from the conventional track—which is the root of some types of errors, yet is also, many contend, a source of creativity. "To err is human" is a truism with important implications for the workplace; ignoring it can bring catastrophe.

Take the highly specialized work environment of an airliner's cockpit. By studying the layout of the control panel, Senders can see how a pilot could mistakenly shut down the engines in flight as in fact occurred last year. Designers made an error, in Senders' opinion, because they placed the engine controls too close to numerous other switches that are used frequently. Only noncritical controls should be grouped together, he says, and critical controls should be located in control-panel areas not used routinely.

The underlying notion is that common elements promote error. According to Senders, "If someone plans to do Task A, then decides instead to do Task B, the more common elements [there are] in the two tasks, the greater the likelihood of error. Things that are done very often should be surrounded by things not very important."

At Sandia Laboratories, in Albuquerque, workers were enlisted to participate in their own analysis of how and where errors could occur. Seventy-five participants were asked to identify the possibilities for error in their job of assembling printed circuit boards. These were the real experts, since they were most familiar with the task, and they identified 157 significant difficulties that promoted error in their jobs.

One difficulty centered on a drawing of the assembly; the drawing was on a sheet of paper separate from its explanatory notes. In practice, the workers often relied upon their fallible memo-

MANAGING YOUR BUSINESS**Errors On The Job Can Be Reduced**

ries for the information in the notes, rather than take the time to find the notes. Says Swain: "One of the fundamental principles in the design of written materials is that if they are difficult to locate, or difficult or inconvenient to use, they will seldom be used."

Task analysis of a specific, error-producing situation often results in significant improvements. But management must be forgiving, because employees are more likely to cooperate in the postmortem of an error when they understand that its purpose is to upgrade the work environment, not to fix blame or exact punishment.

Swain cites an example that took place in a laboratory where a chemist was conducting experiments with tritium, a radioactive gas. A potentially dangerous leak occurred, and Swain was called in to analyze the incident. He interviewed the chemist and his assistant, and watched them at their tasks.

His observations and recommendations, while specific to the incident, illustrate general principles. For example, he learned that the assistant was new on the job, which raised a red flag. A supervisor, says Swain, should assume that a new employee is more likely to make an error.

The technician had been required to replace an empty bottle of tritium with a new one. Although he had not been trained for the task and there were no written instructions for it, he believed he could accomplish it. While such initiative may be laudable for some tasks, it can be dangerous for others. New employees should be instructed not to exceed their training in critical areas.

The lack of written instructions increased the risk of error, Swain says. Experienced workers generally assume that their oral instructions are fully understood by inexperienced workers, he says, and those who are inexperienced don't like to admit that sometimes they do not fully understand what they have been told.

The critical mistake in the incident of the tritium leak occurred when the technician left the tritium valves open when he removed the old bottle. But Swain also says the designers of the system were at least as culpable as the employee. The valves had no indicators for determining whether they were open or closed. One valve was beneath the apparatus, an error-producing placement described as "out of sight, out of mind."

Furthermore, the gauges monitoring the valves were in a remote position. And although the tritium release set off automatic alarms, employees ignored them because the laboratory had been plagued by previous false alarms.

Studying such an error in retrospect is vital to the safe conduct of future business, and it may be a grievous error in itself simply to blame the employee who happened to be on the scene at the time.

After the accident at the Three Mile Island nuclear power plant in Pennsylvania nine years ago, Senders studied the basic design of a nuclear-plant control panel. He found a confusing maze of some 3,000 instruments and switches. There were countless errors waiting to happen, he concluded.

At one plant, two identical switches were placed side by side, yet they regulated the reactor control rods in critically different ways. It would be simple to throw the wrong switch and produce a disaster. Realizing this, the operators had to make a distinction—something that the designers should have done for them. The operators attached a Heineken beer tap handle to the "rod control" switch and a Michelob handle to the "partial rod control" switch in order to remind themselves which was which.

The potential for error is all about us. The close spacing of buttons on a telephone makes it easy to reach a wrong number. The compact keyboards on miniature calculators can foster math errors. You may turn on your car's windshield wipers when you mean to dim your headlights if those functions are controlled by the same knob.

We must redesign our philosophies of design, says Senders. We must make machines compatible with the way people function, rather than make them so similar that their sameness promotes error.

Senders contends that the *ability* to err is a special, even beautiful human trait, and there may be no way to eliminate it. It is desirable to reduce the quantity of errors, and it is necessary to lessen their consequences. But we cannot—nor would we wish to—eliminate the tantalizing capacity of the human mind to discover random new pathways. "Imagine a human being who didn't make errors," says Senders. "Other people wouldn't see the error-free person as human. He or she would be incredibly dull." ■

To order reprints of this article, see page 61.

Houston, A., & Dockstader, S. L. (December 1988). A total quality management process improvement model (NPRDC Tech. Rep. 89-3). San Diego: Navy Personnel Research and Development Center.

This report describes a model for the systematic improvement of an organization's products or services through analysis and correction of the processes that create them. The model is an elaboration of the Plan-Do-Check-Act (PDCA) cycle developed by Shewhart and Deming for process analysis and improvement. The thrust of this project was to enhance the performance of naval logistics organizations through the application of TQM principles and methods.

The report describes an approach to integrating the procedures of process improvement with an organization made up of cross-functional teams to improve both vertical and horizontal communication. The authors provide a detailed description of the roles and activities of two important teams--Quality Management Boards (QMBs) and Process Action Teams (PATs)--and how they function within the context of the PDCA cycle. The appendices include an exercise for developing a process flowchart, exercises in creating Pareto charts, a format to follow in writing up a case study, and a fictitious case study to demonstrate the use of the format.

A TOTAL QUALITY MANAGEMENT PROCESS IMPROVEMENT MODEL

A. Houston
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Approved for public release;
distribution is unlimited.

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San Diego, California 92152-6800

INTRODUCTION

Background

In an effort to improve quality and productivity, Navy industrial organizations are adopting a management approach known as total quality management (TQM). This approach is based on a set of management practices and statistical measures that, when combined, can remove the causes of poor product quality and excessive cost (Dockstader, Doherty, & Konoske, in press; Houston, Shettel-Neuber, & Sheposh, 1986).

The management practices and analytic methods adopted by the Navy's aviation maintenance organizations are based primarily on the TQM concepts of W. E. Deming (1986). Some of the critical concepts are:

- . Quality is defined by customers' requirements.
- . Top management has direct responsibility for quality improvement.
- . Increased quality comes from systematic analysis and improvement of work processes.
- . Quality improvement is a continuous effort and conducted throughout the organization.

Appendix A provides a complete listing of Deming's management principles. Dockstader, Doherty, and Konoske (in press) discuss them in depth.

The TQM approach emphasizes the major role that managers have in achieving quality and productivity improvement for an organization. Deming and other TQM proponents such as Crosby (1979) and Juran (1974) estimate that up to 85 percent of quality improvement is under direct control of management and can not be remedied by the hourly employee or staff member.

Under the TQM approach, managers are expected to achieve quality improvements through the use of a process improvement approach known as a "Plan-Do-Check-Act" cycle (see Figure 1). This approach was originally associated with the analytic work of Shewhart (1931), a colleague of Deming.

This cycle is now closely associated with Deming's philosophy of quality improvement. The cycle, as illustrated in Figure 1, describes a method which is best suited to "off-line quality control" where experiments are conducted. For an elaboration of that approach, see Moen and Nolan (1987). In this technical report, an adaptation of the cycle for "on-line" quality control is presented (Figure 2). In this version of the cycle, management identifies important organizational goals during the "Plan" phase. Activities in the "Do" and "Check" phases involve the identification and analysis of process variables that affect achievement of the goals. During the "Act" phase of the cycle, process corrections and improvements are made and evaluated. Effective changes are formally installed and the process is monitored to maintain the improved performance. The cycle is then repeated to pursue continuous improvement.

In an effort to assist managers to understand the specific activities in the "Plan-Do-Check-Act" cycle, an elaboration of the cycle was developed by the Navy Personnel Research and Development Center. The cycle is presented in the form of a flow chart and referred to here as the process improvement model (PIM), and is displayed in Figure 3.

THE SHEWHART CYCLE (Deming, 1986)

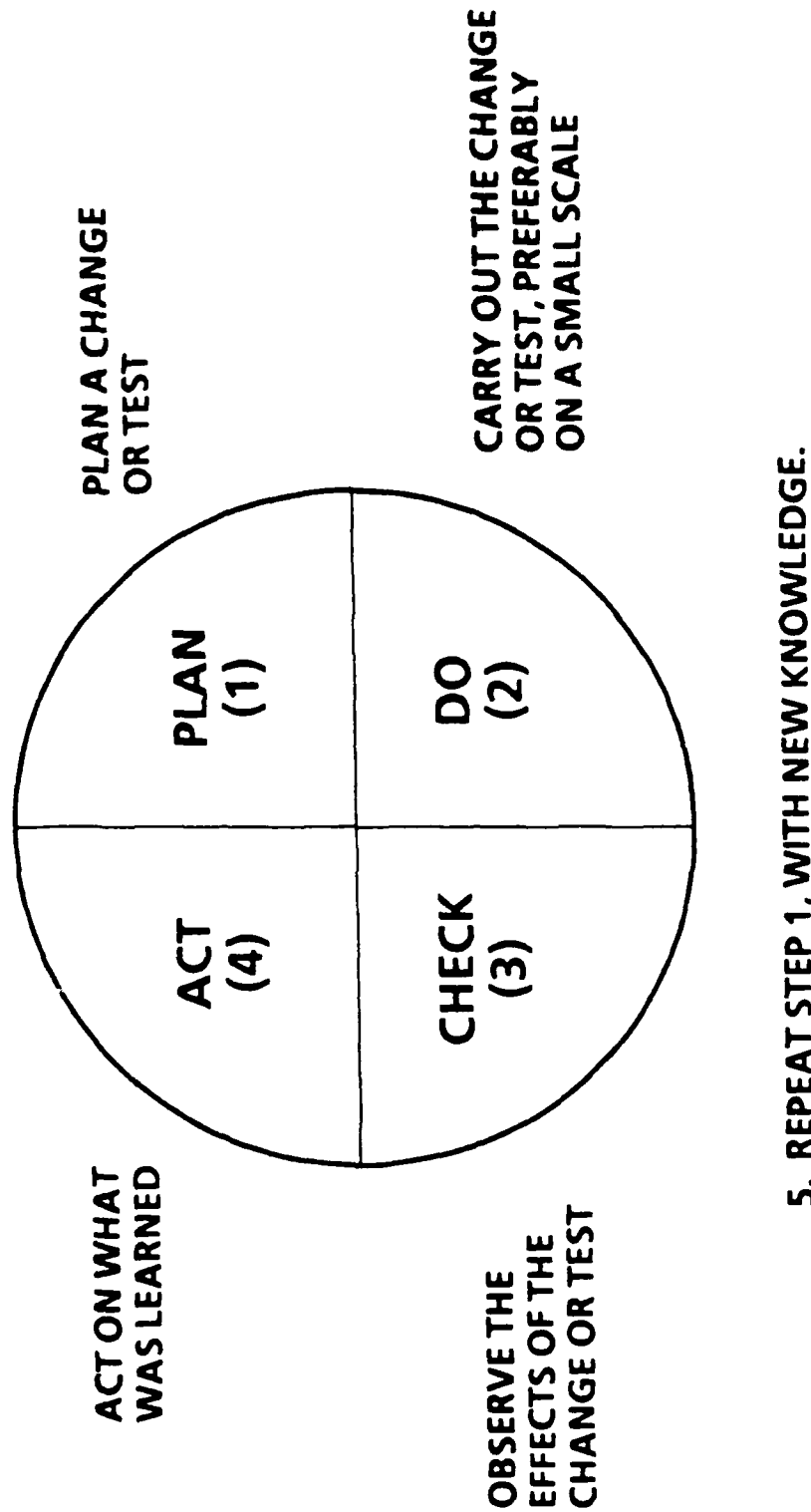


Figure 1. The "Plan-Do-Check-Act" cycle for continuous improvement.

USE OF "PLAN-DO-CHECK-ACT" CYCLE

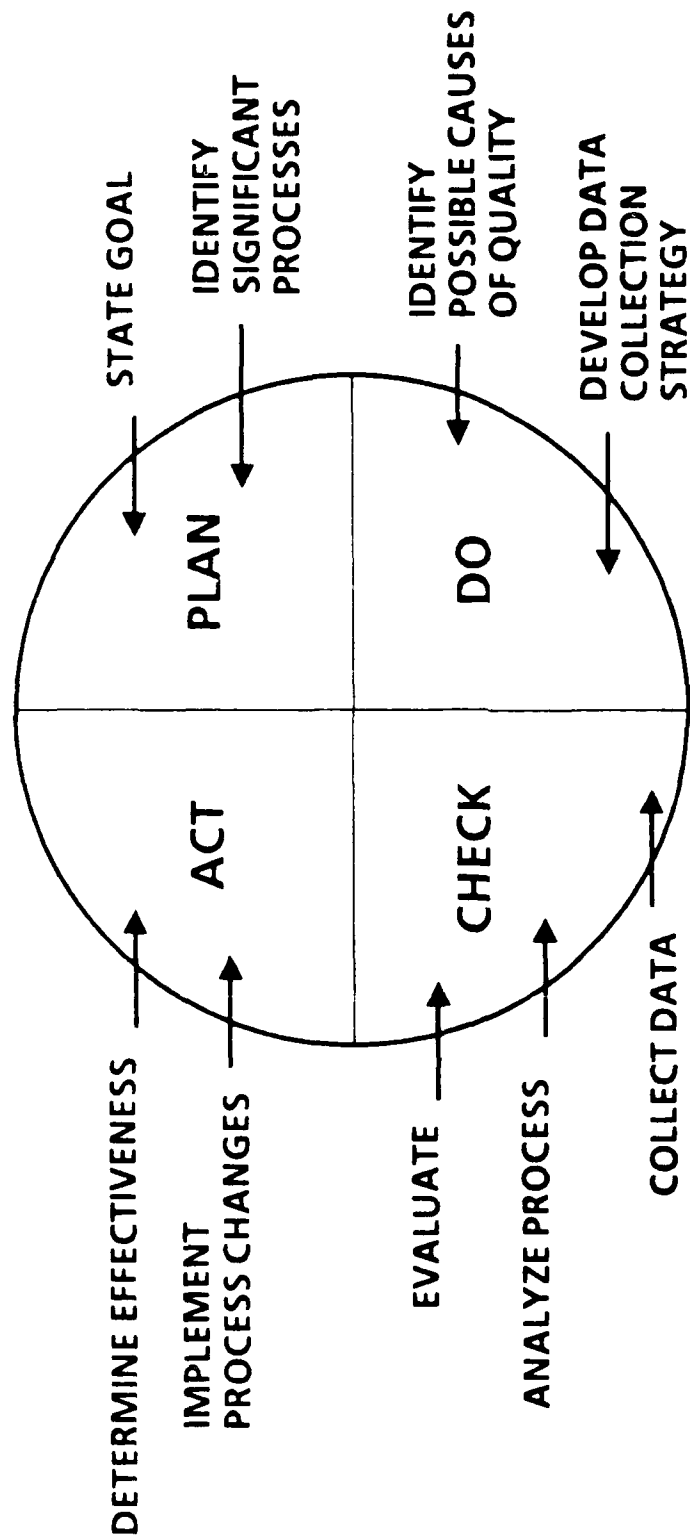


Figure 2. The "Plan-Do-Check-Act" cycle during process improvement.

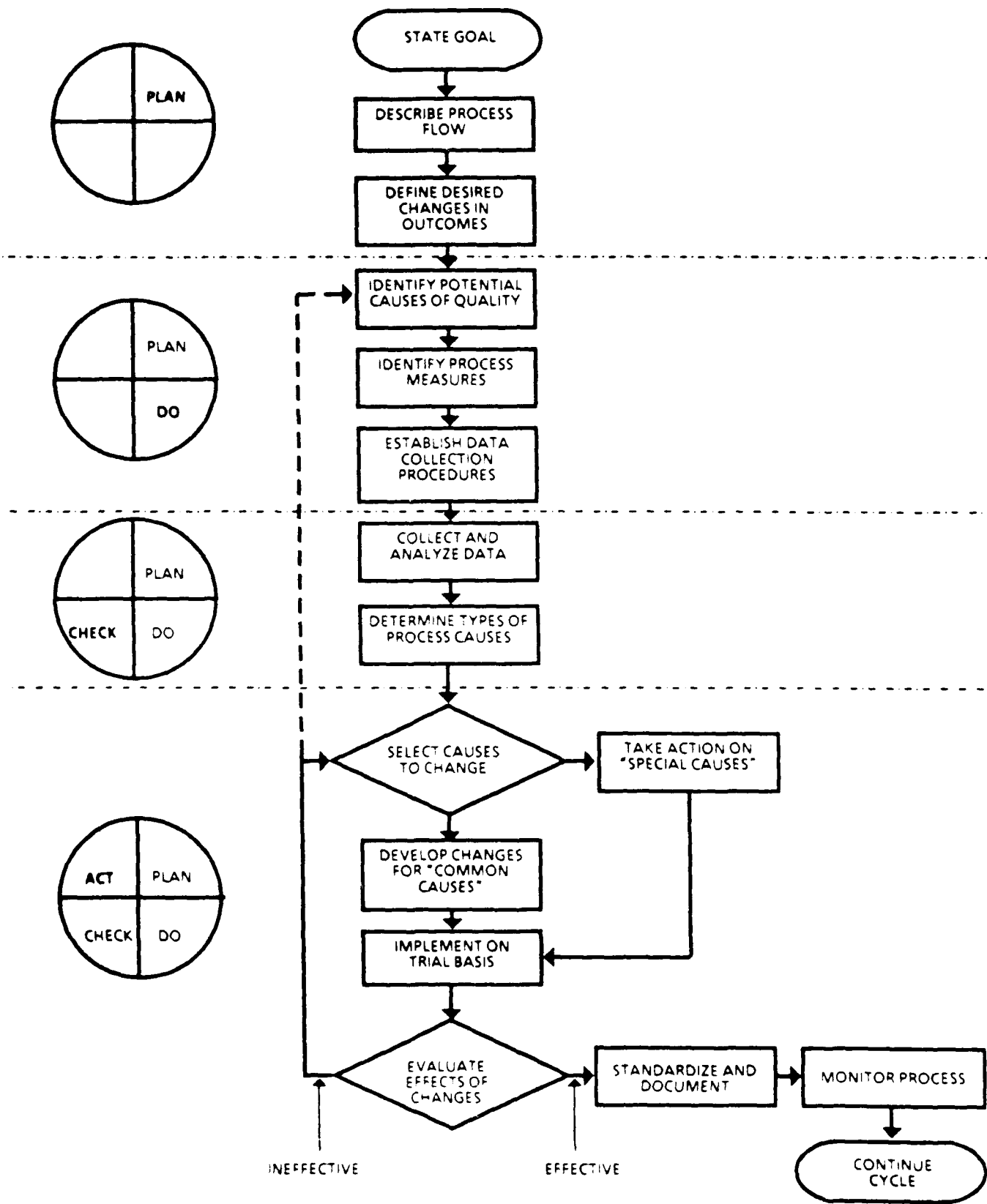


Figure 3. Process improvement model for total quality management.

Purpose of Report

The use of TQM principles and the "Plan-Do-Check-Act" cycle in Navy industrial organizations requires the adoption of managerial practices and responsibilities that managers have little, if any, experience in applying.

This report has been written to serve as a "bridge" between theory and practice. Specifically this report has three objectives: (1) to define the steps of the process improvement model by describing specific activities associated with each step; (2) to describe roles and responsibilities of managers and others in relation to the model; and (3) to give a brief overview of basic statistical process control methods.

This report is not a "how to" manual for improving product quality, but rather documentation of one approach to process improvement that might have general applications. The reader is encouraged to consult other writings on the subject (e.g., Moen & Nolan, 1987; Tunner, 1987) and more technically comprehensive treatments of statistical process control methods (A T & T, 1956; Grant & Leavenworth, 1974; Ott, 1975).

ORGANIZATIONAL STRUCTURE

The use of PIM requires cooperation and coordination of all organizational levels. The following organizational structure is presented as a way to manage people involved in process improvement efforts. The structure consists of three levels: Executive Steering Committee, Quality Management Boards, and Process Action Teams.

Executive Steering Committee

Membership

The Executive Steering Committee (ESC) represents the highest level of management and as such is made up of a number of top managers in the organization. For naval organizations, an ESC would probably include the commanding officer and department-level managers.

Function

The ESC identifies strategic goals for organizational quality improvement efforts. It obtains information from customers to identify major product and service requirements. It is through the identification of these major requirements that quality goals for the organization are defined. After the ESC has identified customer requirements, it prioritizes and lists the organizational goals for quality improvement. During the course of quality improvement efforts there will be changes that require support and resources that can only be provided by top management. The ESC is expected to ensure that these requirements are met.

After process changes have been made, the ESC is involved in determining the effectiveness of the changes in meeting the quality needs of customers. As effective process changes are made, the ESC provides the resources needed to standardize and document these changes.

Quality Management Boards

Membership

Quality Management Boards (QMBs) are permanent cross-functional teams made up of top- and mid-level managers who are jointly responsible for a specific product or service (see principle #9 of "Deming's 14 Management Principles," 1986, in Appendix A). The structure of the boards is intended to improve communication and cooperation by providing vertical and horizontal "links" throughout the organization (Ackoff, 1981; Dockstader, 1984).

Although the members of QMBs are expected to be permanent, the chair and the focus of a specific QMB can shift, depending on the current product or service goal. During the formation of QMBs, it is crucial that the members selected have the knowledge and ability to relate the ESC's quality improvement goals to specific outputs and processes.

Function

The QMB carries out the majority of PIM activities. The QMB uses its combined knowledge to select the organizational areas that might have the most significant impact on the goals. The QMB works with the ESC to define indicators of quality improvement and cost reduction.

The QMB organizes ad hoc Process Action Teams (PATs) that collect and analyze information about work processes. As the teams perform their work, the QMB conducts experiments to identify what common causes of variation appear to be most critical to process performance. Based on these causes, the QMB makes changes designed to improve process performance. The QMB tracks the performance of the process to determine the impact of the changes on the selected goals.

Process Action Teams

Membership

Process Action Teams or PATs are comprised of staff and/or hourly workers involved in the processes being investigated by the QMBs. The members of a PAT are chosen by their respective managers on the QMBs. The primary consideration for PAT membership is that the individuals selected be highly knowledgeable about the operations in their shop or unit.

Function

The main function of PATs is to collect and summarize process data for QMBs. A major task of a PAT is to collect baseline information on process performance. PATs use basic statistical process control (SPC) methods to analyze a process and identify potential areas for improvement. It is important to note that PATs and, by extension, the entire PIM are only of use when dealing with quality goals that can be achieved by using objective data. Such data can be achieved by a variety of means, including expert judgments and other scaling methods.

PLAN PHASE (ESC/QMB RESPONSIBILITY)

The Plan phase involves identifying the critical product and service requirements of major customers (see Figure 4). Process improvement efforts are based on these critical customer requirements. The ESC and QMBs work together in translating customers' requirements into appropriate goals.

A fundamental assumption of the TQM approach is that "quality" is defined by the customer. Therefore, the selection of major quality goals must be based on the information received from customers. During the planning phase there are several questions that should be answered:

"Who are our major customers?"

"Which products or services are most important to them?"

"What characteristics of these products or services could be improved?" (i.e., what are the "true" quality characteristics? (Ishikawa & Lu, 1985)).

"What operations in the process have the greatest effect on the products or services?"

"How does the performance of these operations need to change?"

Addressing these questions aids in the development of a quality improvement plan. A well-developed plan enables an organization to concentrate its resources on achieving maximum quality improvements. Failure to develop a well-defined plan with specific, measurable goals can result in wasted time, misused resources, and needless frustration. The following paragraphs describe some of the major activities associated with the "Plan" phase under PIM.

State Goal

A goal within this context refers to some desired change in products or service. Examples of goals could be (1) reducing processing time for customer orders, (2) increasing the service life of a product, (3) shortening delivery time to customers, or (4) reducing the cost charged to the customer.

While TQM is a very effective way of obtaining quality improvements, certain conditions must be met before using the TQM methods and structure to address a goal. For instance, goals addressed by TQM should be *relevant* to the mission of the organization and *measurable*.

Relevant

Selected goals should reflect the potential for significant improvements in the product or service. Avoid "so what?" goals that have little, if any, impact on the central mission of the organization. For example, if the central mission of an organization is to repair naval aircraft, then it is unlikely that a major quality concern would be processing travel orders for personnel. (However, if the business is a travel agency, it may be entirely appropriate to optimize travel processing procedures.) Whenever possible, it is best to establish goals that will provide a direct benefit to the final customer.

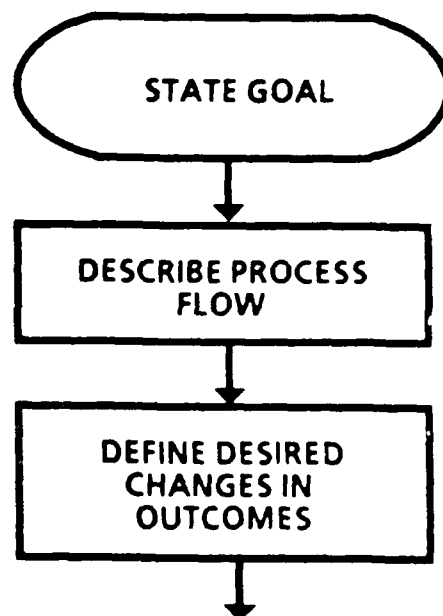
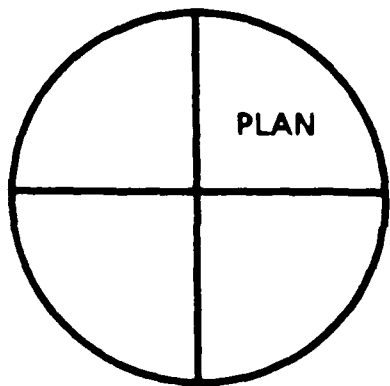


Figure 4. The "Plan" phase of the process improvement model.

Measurable

TQM is often concerned with economically related goals and relies on SPC methods to achieve these goals. Use of these methods requires that goals be defined so that their achievement can be verified by data, not subjective opinion. A goal that can not be measured in some fashion is not appropriate for the process improvement model.

Describe Process Flow

In many traditional organizations, managers and employees are encouraged to specialize in those activities and operations they perform. This emphasis has advantages, such as the development of operational expertise, clear job responsibilities, and well-defined management boundaries. There are potentially serious disadvantages associated with this "departmentalizing" of a work process, however. Some of the disadvantages include: conflict between interrelated operations in separate departments, restriction of needed information, duplicated efforts, and sub-optimization. Sub-optimization occurs when actions are taken to improve the performance of an isolated operation to the detriment of related or subsequent operations.

One aid to avoid the disadvantages of a narrow process focus in a QMB is for that group to identify major interrelated process operations and departmental responsibilities. One way of accomplishing this is by using the flowchart method. The flowchart is a graphic method of describing the interrelation of operations and decisions required to transform resources into outputs (see Figure 5).

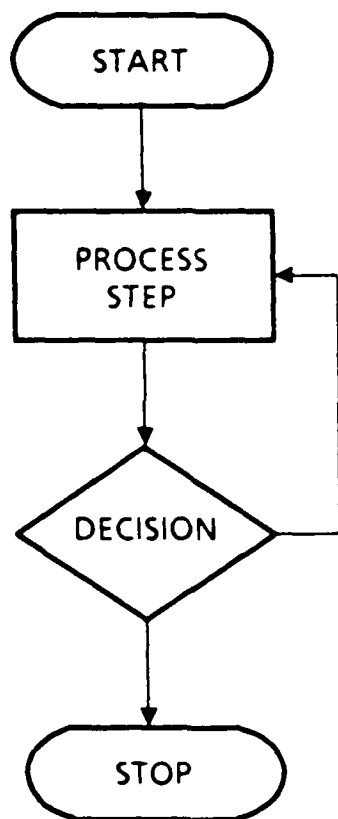
After the QMB has constructed a process flowchart, it should analyze the chart to identify such things as duplicated efforts between operations, "gaps" in accountability, overuse of inspection, and ways to streamline the process. Streamlining a process is sometimes known as "imagineering." During "imagineering" the QMB constructs a flowchart of the ideal process, that is, a depiction of a process that creates perfect products in the most efficient manner. The comparison of the actual operations with the "imagineered" process can then be used to guide improvement activities. Appendix B presents a series of exercises that provide practice in developing and using a process flowchart.

Define Desired Changes in Outcomes

The achievement of quality goals will require specific changes in process performance. A critical task of the ESC and QMBs is to identify and define these needed changes. During the planning and other phases of PIM, there are three types of information that will be needed to achieve and maintain quality improvements. These types of information are: outcome, output, and process.

Outcome

This information represents the customers' evaluation of the product or service. This information can include timeliness, price, or "fitness for use." These measures are provided by customers external to the organization. It is information from such customers that is the basis for defining product or service quality. If the organization's current customer information system is considered inadequate, then different methods of obtaining information must be developed. Failure to obtain accurate definitions of customers' requirements seriously weakens the entire foundation of the TQM approach.



- LINES AND SYMBOLS CHART
- REPRESENTS MAJOR STEPS OF A PROCESS
- FORMS BASIS FOR IDENTIFYING EXCESSIVE COMPLEXITY AND WASTE

Figure 5. Process flowchart.

Output

Output information describes objective features of a product or service. This information typically represents a comparison of critical characteristics of the final product or service with customer-defined requirements. These requirements could address physical specifications, degree of accuracy, manufacturing costs, or time standards. This type of information can usually be obtained through the review of inspection or audit records.

Process

Process information describes the resources and operations required to develop a product or service. This information can address equipment performance, condition of incoming material, variations in work methods, or worker characteristics. In the TQM approach, this information is gathered by individuals who work directly with the process. Process information is collected to identify variables that have the greatest effect on the product or service.

Measures of outcome, output, and processes are used throughout the process improvement cycle. The ESC obtains outcome information to identify major organizational goals. The ESC and QMBs work together to relate the outcome requirements to specific process outputs. They then define how the outputs need to change. The QMBs and PATs work together to identify the process variables that have the greatest effect on output quality. As these variables are changed, output and outcome information is collected. This information is analyzed to check progress toward the quality improvement goals.

DO PHASE (PAT RESPONSIBILITY)

After quality goals have been defined, the process variables related to improved quality need to be identified. The identification of these variables is the task of *Process Action Teams* (PATs). PATs consist of individuals working on the processes selected for improvement. In the "Do" phase of PIM, these teams have three major responsibilities (see Figure 6). First, PATs study the current process and its outputs to identify variables related to quality. Second, the teams develop measures of those variables. Third, the teams create a format to collect data.

Identify Potential Causes of Quality

PATs are expected to use their experience and knowledge to identify variables that affect output quality. Statistical methods are used by PATs to study process performance. First, information on past performance of output characteristics is gathered. This is known as *baseline information*. Second, a description of the process as it currently exists is developed. It takes the form of an "as is" flowchart. Third, the identification of specific process variables is accomplished through a *cause-and-effect analysis*. The following sections provide further discussion of these steps.

Develop Baseline for Process Outputs

The first step in baseline development is to clearly define what quality characteristics of the process output will be studied. This definition is critical to subsequent process analysis and improvement efforts. Development of a baseline for a process output involves evaluation of the output over a period of time. The purpose is to determine how the process performs prior to and following any improvement efforts.

The output studied by a PAT depends on the type of process. The output of a production process is usually a physical product, for example, automobiles, cameras, or clothing.

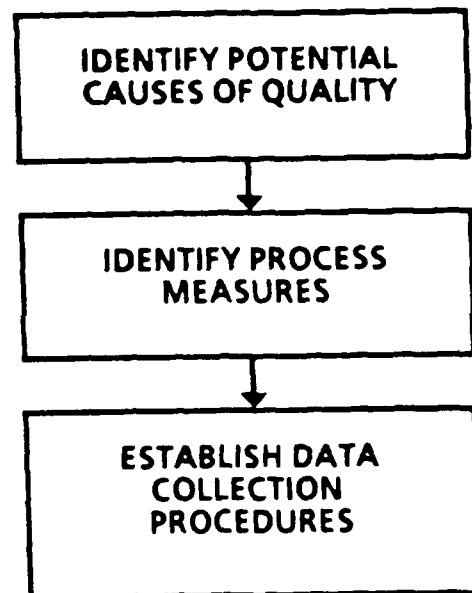
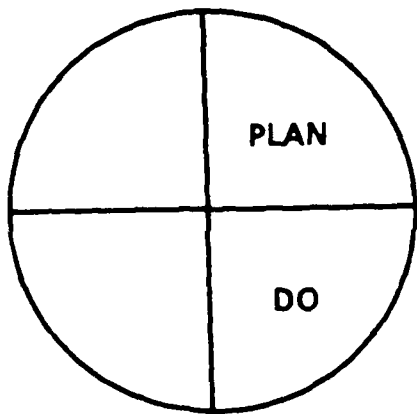


Figure 6. The "Do" phase of the process improvement model.

Such outputs have physical dimensions that can often be quantified and objectively evaluated. The outputs of service processes tend to be more difficult to measure (Albrecht, & Zemke, 1985). Examples of services include medical examinations, haircuts, management consulting, and report editing. The results of these types of processes can vary greatly from customer to customer and are often evaluated on the basis of subjective criteria. Thus, collecting baseline information on service outputs can require much more continuous and direct communication with customers than is required when the output is a product.

There is no easy answer for determining what output characteristics should be measured to create a baseline. The characteristics should have a logical relationship to the goals defined by the ESC and QMB. For example, if the goal is to reduce the amount of backlogged material, then a logical output to measure would be the ratio of completed orders over total orders received per day.

Develop "As Is" Flowchart

Each PAT should develop a flowchart that depicts its section of the process as it actually functions. Such flowcharts should be used to "flesh out" formal descriptions of operations. It could be discovered that the "as is" description includes redundant steps or that the informal process omits critical activities. It is also important to determine how the operations within a process interact. Process improvements must relate to the process as it functions. The "as is" flowchart can also serve to provide QMB members with more detailed knowledge of critical processes.

Perform Cause-and-Effect Analysis

Cause-and-effect analysis is a *brainstorming* method used by a team to create a branching diagram. It shows the relationship between a set of possible process variables and a specific process result (Ishikawa, 1983). The results often focused on during cause-and-effect analysis concern quality, costs, or schedule (see Figure 7). Most cause-and-effect analysis concentrates on four categories of process variables. These categories are:

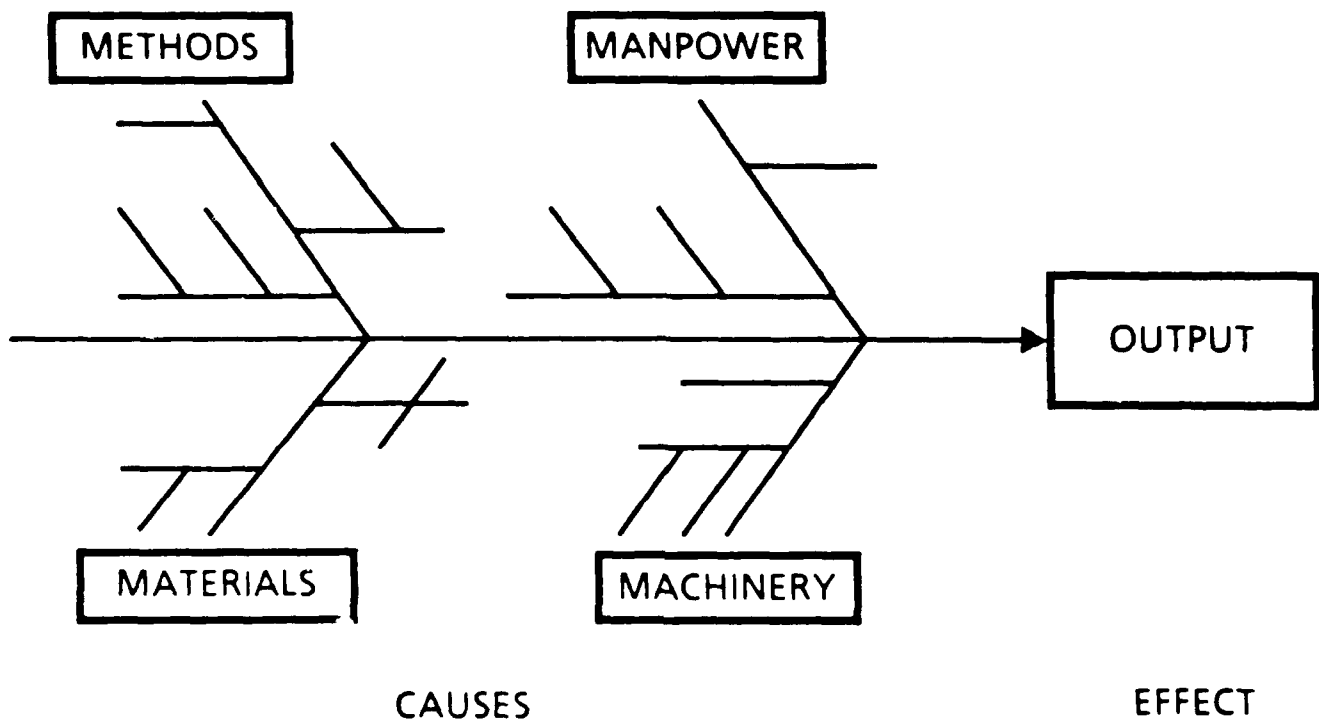
Manpower--the attributes of the people involved in the process such as their experience, training, strength, or even eyesight and reading ability.

Materials--the physical resources or raw materials used in the process; within the setting of Navy aviation maintenance organizations, these resources can include material such as sheet metal, packing material, or chemicals.

Methods--the combination of information and procedures used to create process output. Information sources may be standardized, for example, technical data manuals or forms. Methods can include informal work experiences such as "short cuts" workers learn from others.

Machines--the equipment and tools used in a process. For a supply operation, this could include forklift trucks, computer terminals, or conveyance systems.

While these four categories are commonly used in the identification of important "causes" of process performance, other categories can be added to or substituted for them. The following figures depict an example of cause-and-effect analysis of a problem concerning inventory accuracy in a supply operation (see Figures 8 and 9). Inventory accuracy as presented in the diagrams refers to the location of the correct amount of material within its assigned storage space. Inventory accuracy is the result or "effect" of a combination of variables or "causes."



- BRAINSTORMING COMBINED WITH BRANCHING DIAGRAM
- LISTS POSSIBLE CAUSES FOR GOOD OR BAD QUALITY
- SHOWS RELATIONSHIP BETWEEN "EFFECT" AND ITS "CAUSES"
- AIDS IN ANALYZING COMPLEX INTERACTIONS

Figure 7. Cause-and-effect analysis chart.

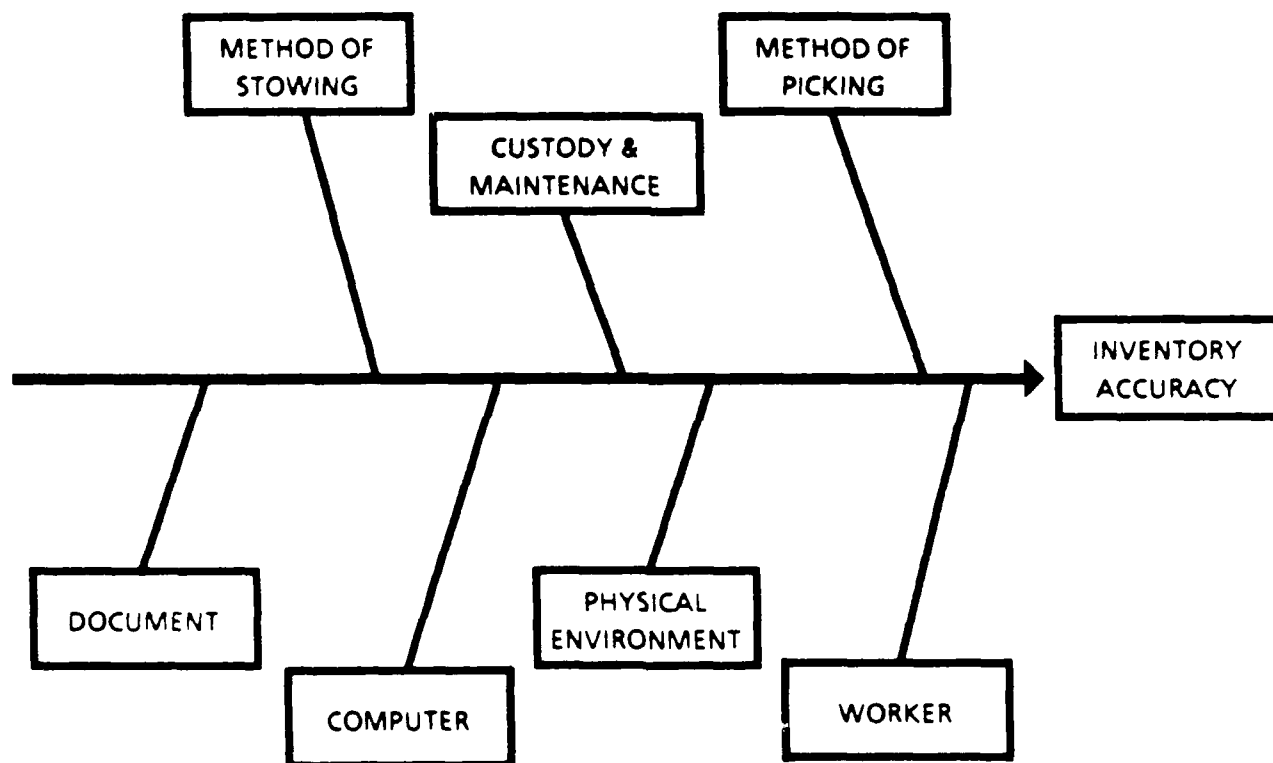


Figure 8. Example of cause-and-effect chart.

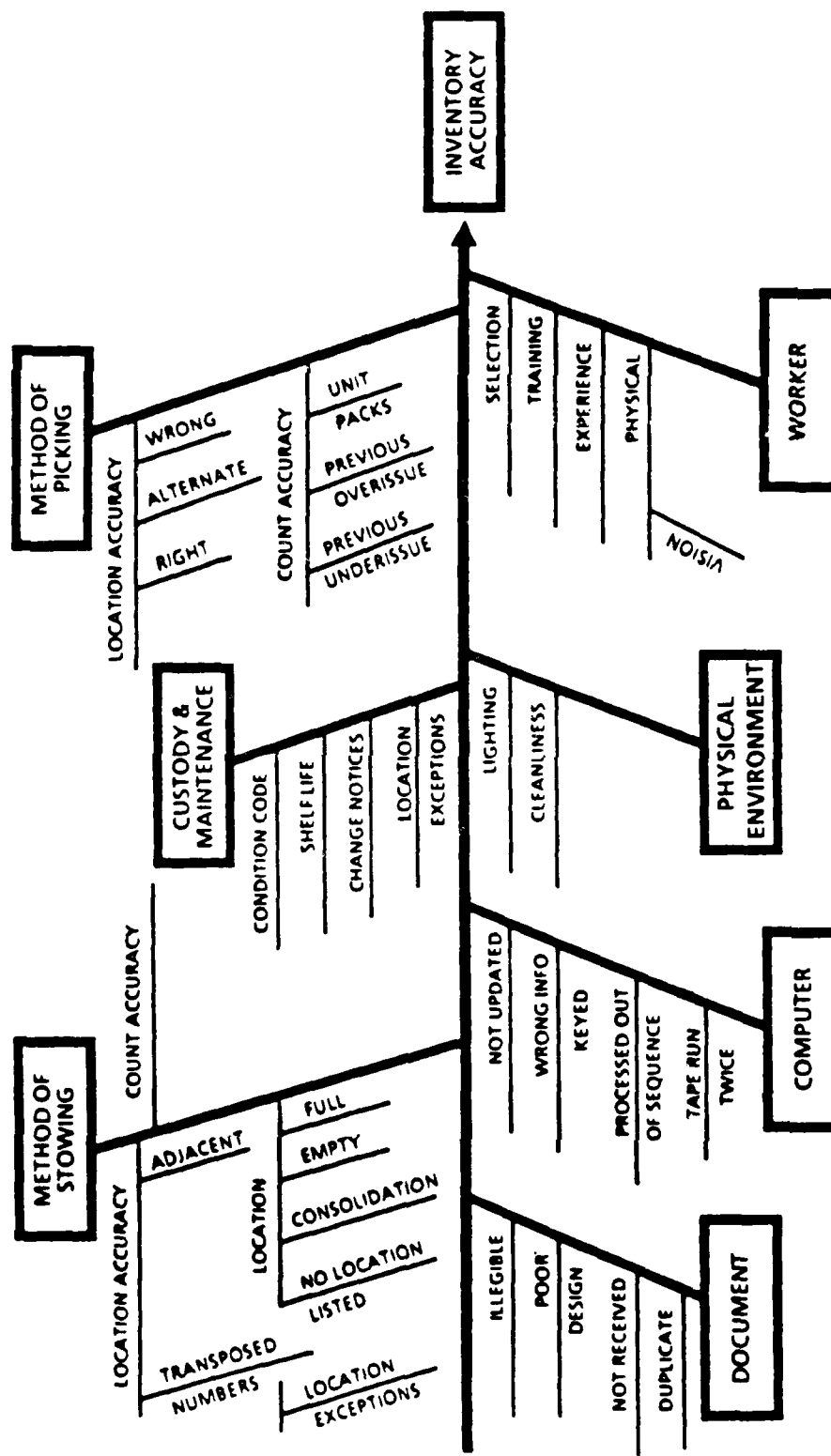


Figure 9. An expansion of information displayed in Figure 8.

The purpose of conducting the cause-and-effect analysis is to identify the variables that appear to have a major influence on process results. Once these potential "causes" have been identified, they can be analyzed using an SPC graph such as a scatter diagram. Such analysis is conducted to verify that the "causes" significantly affect process performance. The variables identified during the cause-and-effect analysis are also studied to determine the type of influence these variables have on process results.

Identify Process Measures

As important as it is to have valid data on outcomes and outputs, it is vital to obtain process measures as well. Unfortunately, organizations rarely have systems established to collect data on process characteristics. When such data are not available, it becomes necessary to develop the process measures.

Developing process measures is not easy. Take, for example, a process variable such as legibility of documents. Members of a team might agree that it is critical to performing their job, but measuring the legibility of a form could be very difficult.

Unfortunately there is no single method of developing measures for process variables. This is a problem that each team will have to work through by using its best judgment. However, once process measures have been identified and developed, it is possible to statistically determine the validity and reliability of these measures. As more knowledge is acquired on processes, the easier it will probably become to determine what variables should be measured and how they should be defined.

Establish Data Collection Procedures

After the PAT has developed measures, it must decide how to collect the data. Data must be collected in a systematic fashion to ensure accuracy of analysis and interpretation. After it has been collected, it is analyzed to identify those variables that are most critical to quality.

Collect Baseline Process Information

The first part of the data collection strategy requires that the team collect information on the "causes" of variation identified through cause-and-effect analysis. This information is collected to determine how the various "causes" influence the output or "effect." Five questions need to be addressed prior to collecting baseline data on "causes":

What process information will be collected? This question concerns the type of information that will be collected on each "cause." In some cases a measure is a simple tally, for example, counting defects in a product, counting forklift trucks available at a receiving dock, or counting documents that are illegible. Some variables require detailed measurement, for example, visual acuity of material handlers, size of packages received from vendors, or minutes required to assemble and deliver an aircraft component kit.

How will the data be collected? There are a number of issues that need to be addressed here. First, the PAT must develop a standard data collection format. In some cases this might require the team to construct check sheets or other recording forms. The individuals who use the forms must use them in a consistent fashion. The second issue is that of sampling. Sampling involves collecting data in such a way that it represents the effect of process variables accurately. A professional statistician is often required to ensure proper sampling.

Who will collect the information? An obvious, but sometimes overlooked, item is deciding individual responsibility for data collection. If individuals are not given specific data collection tasks, there is considerable danger of "things falling through the cracks," that is, data collection failing to be carried out because no one was responsible for it. The individuals selected to conduct data collection should be able to do so as a routine part of their duties. This is likely to occur when the data collector works in the part of the process where the variable is found. For example, if a team is concerned with inaccurate documentation attached to vendor-supplied material, then someone who currently checks documents at the receiving operation would be an appropriate choice as a data collector.

Where will the data be collected? The PAT must decide at what points in a process data should be collected. The "as is" flowchart developed by the PAT could be used to identify appropriate process data collection points. Data should be collected on "causes" at the points where they occur, rather than waiting to infer the existence of the "cause" through a change in the "effect." For example, an insufficient number of wooden pallets could be identified as a "cause" of material backlog in a storage area. It would be more appropriate to measure the difference between available versus needed pallets than to measure the amount of backlog to determine whether or not the supply is adequate.

When will the data be collected? This question refers to identifying deadlines for data collection activities. Data collection deadlines are used to obtain process data in a timely manner. The time span should be long enough to provide a representative sample of measures. For example, if it takes a hour to process an aircraft component, then collecting data once a week could miss valuable information. In this instance, collecting data on an hourly basis during each work day would be more appropriate. Expert assistance from statisticians or operations analysts could be used to help the team determine an adequate time frame.

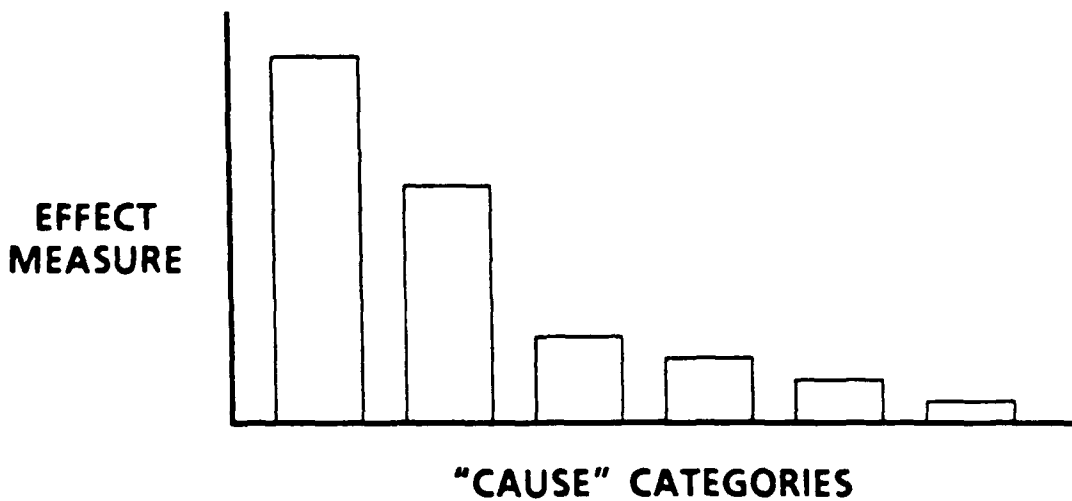
Perform Pareto Analysis

After baseline measures of the process "causes" have been gathered, the relative importance of the "causes" must be determined. Rather than expend the organization's resources to correct a host of "causes" all at one time, it would be more effective to address those "causes" that have the greatest impact on the "effect" first. A method commonly used to identify the most important "causes" is the Pareto analysis (see Figure 10). This analytic technique involves the use of a vertical bar chart that depicts "causes" sorted in descending order according to their impact on the selected "effect."

A Pareto analysis could be used to display the relationship between such data as

- . Types of accident (cause) compared with labor hours lost (effect).
- . Vendor sources used (cause) compared with defective material found (effect).
- . Complexity of travel requirements (cause) compared with time required to process orders (effect).
- . Type of product defects (cause) compared with the cost of reworking the product (effect).

From a review of a Pareto chart, a PAT could identify those variables that have the greatest effect on an output characteristic. Those variables could then be analyzed to determine their precise influence within the process. Appendix C presents an exercise that can be used for



- VERTICAL BAR GRAPH OF DISCRETE DATA
- USED TO RANK IMPORTANCE OF CAUSES
- AIDS IN SELECTING IMPROVEMENT AREAS

Figure 10. Pareto chart.

developing a set of Pareto charts. The following section describes the methods frequently used to study process variables.

CHECK PHASE (PAT/QMB RESPONSIBILITY)

Collect and Analyze Data

In the "Check" phase (Figure 11), the PATs collect process and output data. During the data collection period, they summarize the data using graphic methods. Once the data have been summarized, the PATs and QMBs interpret the findings to confirm which process variables have a significant effect on outputs and, subsequently, outcomes. As significant variables are identified, statistical experiments are conducted to determine the precise type of effect each variable has on output quality.

In addition to flow charts, cause-and-effect diagrams, and Pareto charts, there are four other methods commonly associated with process analysis--histograms, scatter diagrams, run charts, and control charts (G.O.A.L., 1985; Houston, Hulton, Landau, Monda, & Shettel-Neuber, 1987; Ishikawa, 1983). These graphic methods are presented below along with brief definitions.

It should also be pointed out that these are the most basic analytic methods and are most often used with "on line" process analysis. Other more advanced techniques associated with design of experiments (A.T.&T., 1956) are beyond the scope of the present discussion.

Histograms

These graphs can be used to depict variation in process performance or results (see Figure 12). They can also be used to show how the majority of process outputs compare with a goal value as well as with its specification limits.

Scatter Diagrams

These diagrams are often used to check the strength of the possible "cause-and-effect" relationships identified in the "Do" phase. These diagrams can be used to show if changes in a process variable result in changes in the output (see Figure 13).

Run Charts

These charts are constructed to determine if there are time-related patterns in process performance (see Figure 14). They can also be used to test "before" and "after" effects of process changes.

Control Charts

These charts depict process performance from samples taken over a period of time (see Figure 15). Control charts can be used to predict how a process should perform under stable conditions. These charts can be used to distinguish among variables that consistently affect all of a processes' outputs ("common causes") and those that have an unpredictable effect on outputs ("special causes").

These methods are used, when appropriate, by QMBs and PATs to uncover causes of unwanted variation in process performance. Once the data have been graphed, both the PATs and the QMB interpret the findings. Based on the results of their interpretation, process improvement changes are made and evaluated in the "Act" phase.

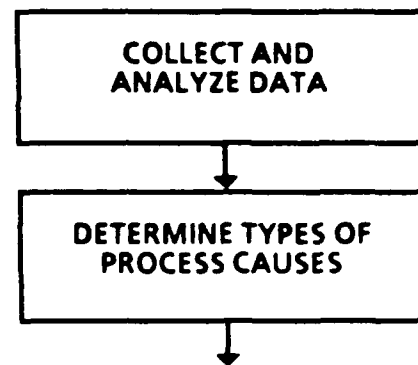
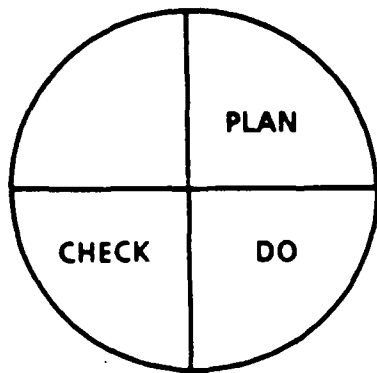
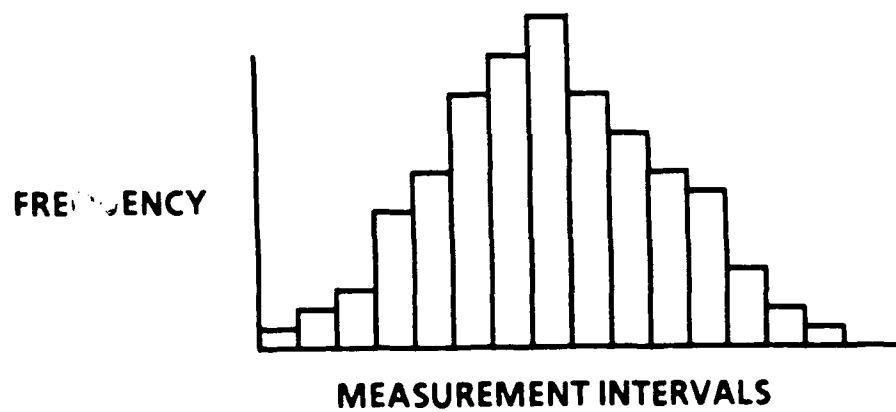


Figure 11. The "Check" phase of the process improvement model.



- BAR GRAPH OF CONTINUOUS DATA
- DISPLAYS AMOUNT AND TYPE OF VARIATION IN PROCESS OUTPUTS

Figure 12. Histogram.

**OUTPUT
MEASURES
(EFFECT)**

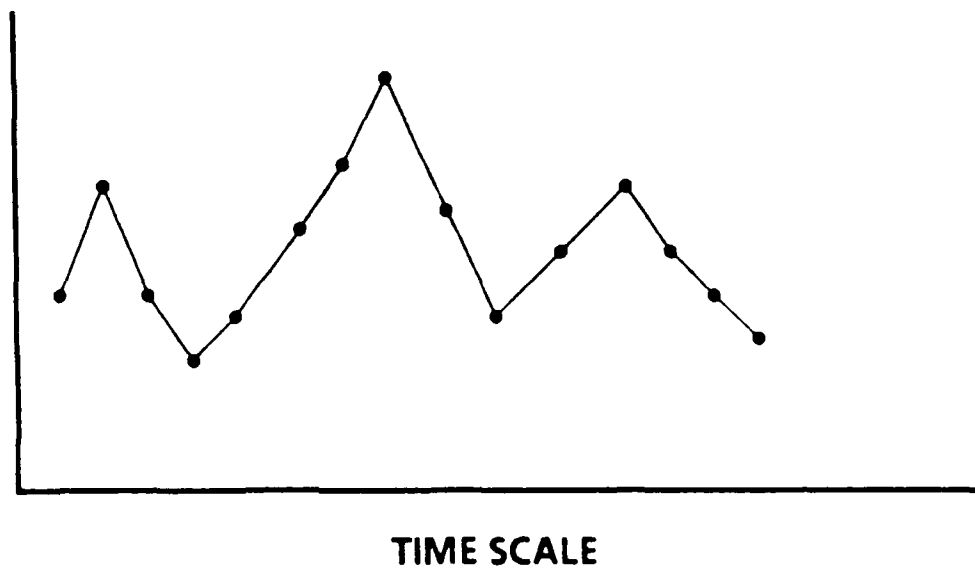


**PROCESS MEASURES
(CAUSE)**

- SCATTER PLOT OF PAIRED MEASUREMENTS
- USED TO TEST RELATIONSHIP BETWEEN A SUSPECTED "CAUSE" AND THE OUTPUT EFFECT

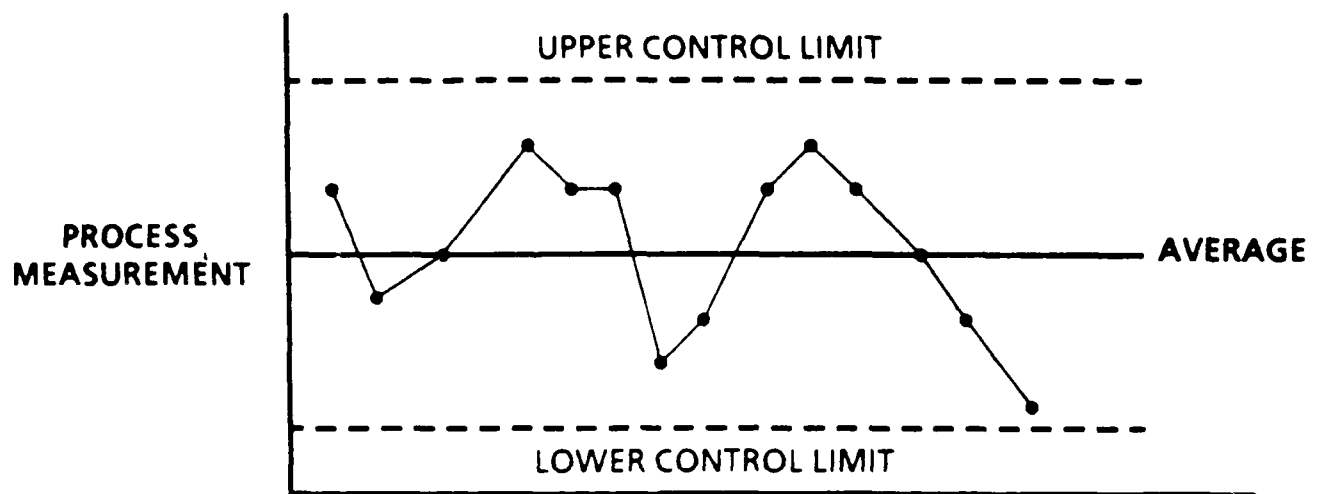
Figure 13. Scatter diagram.

**PROCESS
MEASUREMENT**



- LINE GRAPH
- SIMPLE DISPLAY OF PROCESS PERFORMANCE OVER TIME

Figure 14. Run chart.



- LINE GRAPH WITH ESTIMATED PERFORMANCE PARAMETERS
- EVALUATES STABILITY OF A PROCESS
- DIAGNOSES PROBLEMS (PROBLEM ANALYSIS)
- ASSESSES EFFECTS OF IMPROVEMENT ACTIONS (PROCESS CONTROL)

Figure 15. Control chart.

To assist in the selection and use of appropriate analytic methods, some organizations provide their QMBs and PATs with "process consultants," specifically trained to provide instruction in the analytic and problem solving methods associated with TQM. In the absence of specially trained consultants, it is often necessary to have a professional statistician to help with these matters.

Determine Types of Process Causes

Before taking actions to improve quality, QMBs and PATs should determine what types of "causes" or variables are within the process. "Causes" have either a "common" or "special" influence on a process. Common causes are those that arise from the system itself and influence overall performance in a statistically predictable fashion. Examples of common causes could include the accuracy of standards supplied to a work area, the training given to workers, or the consistency of materials used in the process.

Special causes refer to variables that are not regarded as part of the system and have isolated and statistically unpredictable influence on outputs. Special causes are often "local" to a specific operation, machine, or lot of material. Examples of special causes include a bad lot of material, a single malfunctioning machine, or a new worker using inappropriate procedures. Sometimes the source of a special cause can not be determined or could reflect an unusual statistical event (sometimes known as "bad luck").

Failing to identify the exact nature of a problem could result in short-term "solutions" (band-aid solutions or quick fixes) being used on long-term problems. This is usually the result of incorrectly assuming that a common cause is a special cause. It is also possible to err by implementing broad-scope, long-term changes on what could have been a short-term aberration. Common and special causes can often be identified through the use of control charts (Wheeler & Chambers, 1986).

ACT PHASE (QMB/ESC Responsibility)

Select "Causes" to Change

At the conclusion of the "Check" phase, the PATs select process variables believed to be major contributors to process quality. These variables are used during the "Act" phase in efforts to improve process quality (see Figure 16). At this point in the model, a critical task of the QMBs is to identify those variables that can be handled at the lower organizational levels and those that require the efforts of upper management. Typically, actions on special causes, those isolated and unpredictable process influences, can be dealt with at the worker or first supervisory level. Changing common causes, those variables that affect total process performance, usually involve major changes that require the attention of higher management.

Take Action on "Special Causes"

In some cases it is necessary to take corrective action as soon as a "special cause" is identified. If unsafe working conditions are discovered, it is not necessary to wait until all of analytic efforts have been carried out to improve the working conditions. Early in an organization's TQM effort many "causes" identified could require immediate action. Often these actions can be taken at the lowest organizational level. For example, a PAT might identify a machine with an incorrect setting; the team members could have the authority to

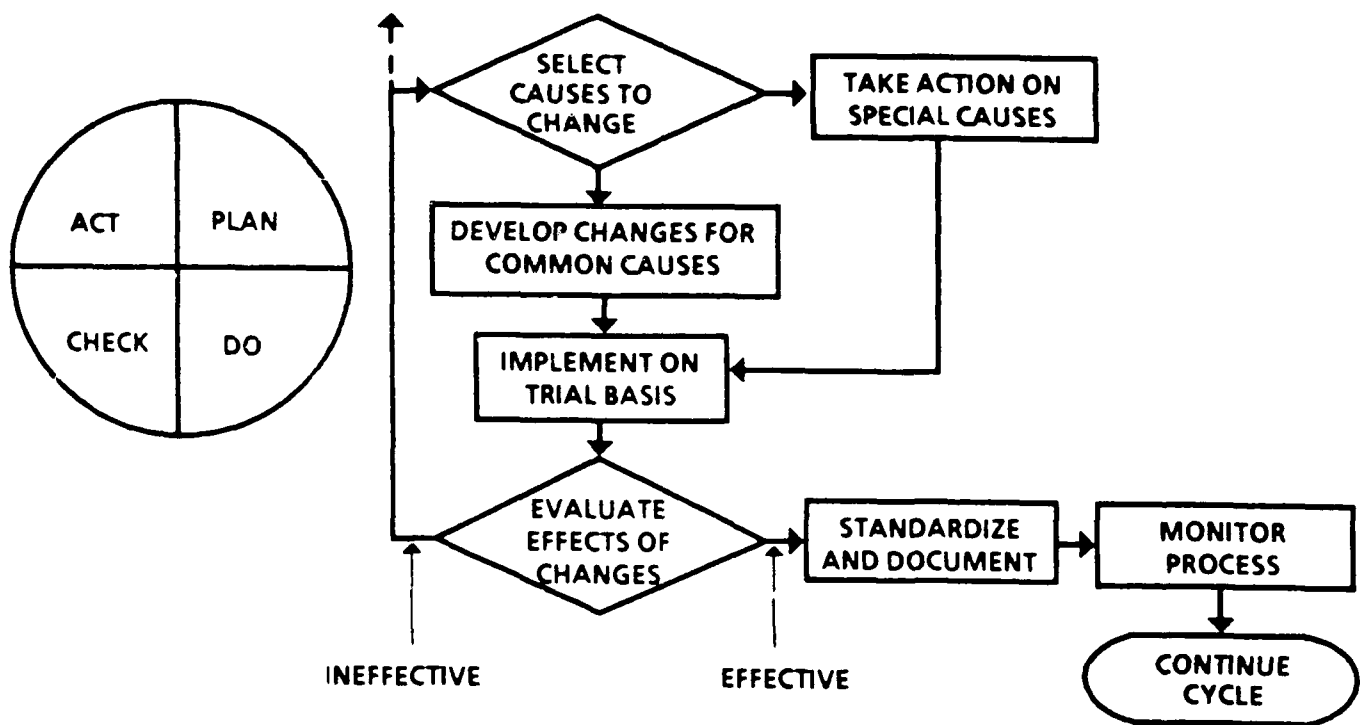


Figure 16. The "Act" phase of the process improvement model.

correct the setting without any management assistance. It should be remembered that the main purpose of correcting special causes is to stabilize a process. After a process is stabilized it is possible to address common causes and improve overall performance.

Develop Changes for "Common Causes"

As a process is stabilized and common causes are identified, the QMBs and ESC work to improve process-wide influences on quality. The QMBs and ESC identify the resources and authority levels required to make the changes. As part of the change design, the QMBs and ESC will have to decide how long a trial period should be used to test the change. Two factors that should be taken into consideration are the nature of the change and production time. Some changes might take a relatively short time to put in place and be expected to show immediate results. Other changes could require a longer period of time to install and affect the outputs.

The determination of trial periods should be decided using statistical criteria before the change is implemented to avoid incorrectly evaluating the effectiveness of a change. For example, a change might be considered to be effective before it is actually tried. And once it has been put in place, any positive results could be interpreted as sufficient evidence that it was working. The "trial" would then be stopped and a potentially ineffective change established as part of the process. By collecting data for a sufficient time period, changes that only have a temporary effect can be ruled out.

Implement Common Cause Changes on a Trial Basis

After changes have been designed by the QMBs and the ESC, the changes are put into effect for a trial period. The QMBs continue to work with the PATs and others involved in the changes to ensure that the design plan is properly executed. Failure to follow the change plan could lead to poor results and the discontinuing of an effective process change.

Evaluate Effects of Changes

After the process change, QMBs and ESCs need to evaluate the effect of the change relative to the original goals identified during the "Plan" phase. Evaluation should be conducted at the process level, the output level, and the outcome level. These levels of evaluation are used to determine if the process change should be standardized or if further investigation is required. The following sections describe evaluation activities.

Collect and Analyze Process and Output Data

Once changes have been installed, the process is allowed to operate for the pre-selected trial period. Data are collected by PATs to assess the effects of the change, for example, use of a run or control chart to determine if the change has a significant influence on the output characteristic. The findings of the PATs are summarized and submitted along with graphs to be reviewed by the ESC and QMBs. QMBs integrate the data obtained from PATs to form a complete description of the effects that changes have had on outputs.

Determine Impact on Outcomes

After the PATs have completed their collection of evaluative output data, the QMBs and the ESC compare those data with outcome information. The purpose of this comparison is to determine what effect the changes have made on the meeting of customer requirements. It is possible that a change could have a positive effect on performance at an internal level without those benefits being transferred to the user of the product or service. That is why it is very

important for the QMBs to identify all of the major process operations during the "Plan" phase. If a critical operation is ignored within a process, its poor performance could neutralize other gains.

Determine if Original Improvement Goals have been Achieved

After reviewing evaluation data, the QMBs and ESC must determine if the process improvement goals have been achieved. If the changes lead to desired improvements, then the QMBs and ESC take the steps needed to make the changes permanent parts of the process. If there has been no significant change in the outcomes selected during the "Plan" phase, then other possible causes of performance must be investigated. This could require returning to the lists created during the "Plan" and "Do" phases and selecting different variables to work on. In an extreme case, a new set of "causes" might have to be identified for the process.

Standardize and Document Process Improvements

If the results show a significant increase in process quality, then the QMBs and ESC take actions to make the changes permanent. Such actions could include changing specifications, work methods, vendors, or providing new training to workers.

An important step in maintaining process improvements is documentation of improvement actions and results. By recording such efforts it is possible to develop case studies for the continuing education of managers new to the TQM approach, for informing vendors of their responsibilities under a changed process, and for briefing customers on the organization's efforts to meet their requirements. Appendix D presents a case study format and guide that could be used to document process improvements. Appendix E presents a fictitious case study to demonstrate the use of the format.

Monitor Process

The "final" step of this model is the establishment of monitoring procedures. Once a process has been improved so that it meets the requirements of customers, then the process changes that led to the improvement must be maintained. Maintenance of a process at a higher level of quality requires the ongoing measurement of critical process variables. The purpose of such measurement or monitoring is to ensure that process performance does not deteriorate.

At the conclusion of a successful improvement effort, the participating groups should develop the procedures and forms necessary to monitor the process. Unlike the previous process analysis efforts, data collection for monitoring is expected to be a regular task of the people involved in the process. Simplicity in data collection and analysis should be a major consideration in the development of a monitoring system.

Continue Improvement Cycle

Although this model focuses on the individual process improvement effort, it should be remembered that under TQM process improvement efforts are a continuous activity. The ESC should always search for new areas for improvement. At the organizational level, the ESC works to address new customer concerns and requirements as the previous goals are met. This could require increasingly detailed customer information systems. At the QMB and PAT levels, continuing efforts to reduce process variation and refinement of process improvements provide additional quality gains.

CONCLUSION

Although the process improvement model was developed for naval logistical organizations, the activities presented in the model could be applied to a variety of organizations, private as well as public.

The major impediments to the use of the process improvement model and, by extension, to the use of TQM are not likely to lie in the nature of the process under investigation, but rather to originate from inappropriate attitudes and practices of managers. Successful use of the process improvement model to improve an organization's products and services will be heavily affected by the ability of managers to adopt the concepts associated with TQM.

RECOMMENDATIONS

At this time, no naval logistical organization has completed a process improvement effort based on this model. But based on review of preliminary results, the following conditions are considered essential for its successful application:

1. Managers should understand the principles and techniques associated with TQM.
2. Managers should believe that they are capable of making significant changes in the ways the organization does business.
3. Managers at all levels should have a shared perception that improvement in product and service quality is essential to their organization's mission.
4. Managers should agree that the TQM approach could be used to significantly improve the products and services of their organization.
5. Managers should clearly define their responsibilities as well as the responsibilities of their subordinates in process improvement activities.

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APPENDIX A
DEMING'S 14 MANAGEMENT PRINCIPLES

(A-0)

V-75

DEMING'S MANAGEMENT PRINCIPLES

1. *Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.*
2. *Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.*
3. *Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.*
4. *End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.*
5. *Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.*
6. *Institute training on the job.*
7. *Institute leadership [see point 12]. The aim of leadership should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.*
8. *Drive out fear, so that everyone may work effectively for the company.*
9. *Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.*
10. *Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.*
- 11a. *Eliminate work standards (quotas) on the factory floor. Substitute leadership.*
- 11b. *Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute leadership.*
- 12a. *Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality.*
- 12b. *Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual or merit rating and management by objective.*
13. *Institute a vigorous program of education and self-improvement.*
14. *Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.*

APPENDIX B
PROCESS FLOWCHART EXERCISES

(B-0)

V-79

SPRAY PAINTING PROCESS FLOWCHART EXERCISE (Part One)

This exercise is designed to provide some practice in developing a process flowchart. The following unordered list presents operations for a spray painting process. For this exercise:

- Put the operations in what you think is the most likely sequence of occurrence.
- Indicate the decision points along the process, that is, where you think the quality of the work is being evaluated.

Spray Painting Process Operations (not in order)

- _____ mask non-painted surfaces
- _____ apply first primer coat
- _____ in-process check, second primer coat
- _____ apply final color coat
- _____ in-process check, first color coat
- _____ fill depressions
- _____ touch-up final coat
- _____ sand base metal
- _____ move material to kitting area
- _____ apply first color coat
- _____ sand depressions
- _____ bake first color coat
- _____ sand first primer coat
- _____ Q.C. buy-off final coat
- _____ sand second primer coat
- _____ in-process check, final color coat
- _____ in-process check, sand depressions

_____ sand first color coat

_____ bake final color coat

_____ in-process check, first primer coat

_____ apply second primer coat

(B-2)

V-82

SPRAY PAINTING FLOWCHART EXERCISE
(Part One Answer Sheet Presenting Steps in Order)

- 1 _____ sand base metal
- 2 _____ fill depressions
- 3 _____ sand depressions
- 4 _____ in-process check, sand depressions
- 5 _____ mask non-painted surfaces
- 6 _____ apply first primer coat
- 7 _____ sand first primer coat
- 8 _____ in-process check, first primer coat
- 9 _____ apply second primer coat
- 10 _____ sand second primer coat
- 11 _____ in-process check, second primer coat
- 12 _____ apply first color coat
- 13 _____ bake first color coat
- 14 _____ sand first color coat
- 15 _____ in-process check, first color coat
- 16 _____ apply final color coat
- 17 _____ bake final color coat
- 18 _____ in-process check, final color coat
- 19 _____ touch-up final coat
- 20 _____ Q.C. buy-off final coat
- 21 _____ move material to kitting area

SPRAY PAINTING DEFECT LOCATION EXERCISE
(Part Two)

The following list presents possible defects that could occur during the spray painting process. Identify where in the spray painting process the defects could occur. Use numbers to identify the defects in the blanks next to the process steps.

1. Blisters (raised portions of finish coat)
2. Under-baking (insufficient heat or time in oven)
3. Cracks (break in final coat)
4. Incorrect coating (wrong primer or paint)
5. Over-baking (excessive heat or time in oven)
6. Sanding scratch
7. Roughness ("orange peel," sags, runs)
8. Unfilled depression
9. Contamination (dirt, etc., in coating)
10. Over-spraying (paint or primer on unwanted surface)

Spray Painting Process Steps	Defects that Could Occur at This Step
1--sand base metal	_____
2--fill depressions	_____
3--sand depressions	_____
4--in-process check for depressions	_____
5--mask non-painted surfaces	_____
6--apply first primer coat	_____
7--sand first primer coat	_____
8--in-process check of first primer coat	_____
9--apply second primer coat	_____
10--sand second primer coat	_____

**Spray Painting
Process Steps**

**Defects that Could Occur
at This Step**

11--in-process check of
second primer coat

12--apply first color coat

13--bake first color coat

14--sand first color coat

15--in-process check of
first color coat

16--apply final color coat

17--bake final color coat

18--in-process check of
final color coat

19--touch-up final coat

20--quality control
"buy-off" of
final coat

21--move material
to kitting area

(B-5)

V-85

APPENDIX C
PARETO CHART EXERCISE

(C-0)

V-87

PARETO CHART EXERCISE

In this exercise, you are asked to create two Pareto charts. First, complete the data sheet provided below by calculating the total costs per paint spraying defect. Second, use the frequency of defect information to create a Pareto chart using the worksheet displayed as Figure C-1. Rank the categories of defects from the highest to the lowest frequency. Third, use the total costs of defects information to create a Pareto chart using the worksheet displayed as Figure C-2. Rank the costs of defects from the highest to the lowest.

Use the data provided on the completed worksheets to answer the following questions:

Which three defects appear to occur most often?

Which three defects contribute the most to the cost of repairing defects?

Figures C-3 and C-4 show completed Pareto charts for comparison.

Type of Defect	Frequency of Defect	Rework Costs per Defect	Total Cost*
1. Blisters	<u>20</u>	<u>5.00</u>	<u> </u>
2. Under-baking	<u>5</u>	<u>12.00</u>	<u> </u>
3. Cracks	<u>3</u>	<u>3.00</u>	<u> </u>
4. Incorrect coating	<u>7</u>	<u>18.00</u>	<u> </u>
5. Over-baking	<u>6</u>	<u>14.00</u>	<u> </u>
6. Sanding scratch	<u>26</u>	<u>3.00</u>	<u> </u>
7. Roughness	<u>2</u>	<u>2.00</u>	<u> </u>
8. Unfilled depression	<u>9</u>	<u>1.00</u>	<u> </u>
9. Contamination	<u>4</u>	<u>8.00</u>	<u> </u>
10. Over-spraying	<u>18</u>	<u>4.00</u>	<u> </u>

* Total cost equals frequency of defect times the rework cost per defect. For example, the total cost of "blisters" equals 20×5.00 or \$100.00.

(C-1)

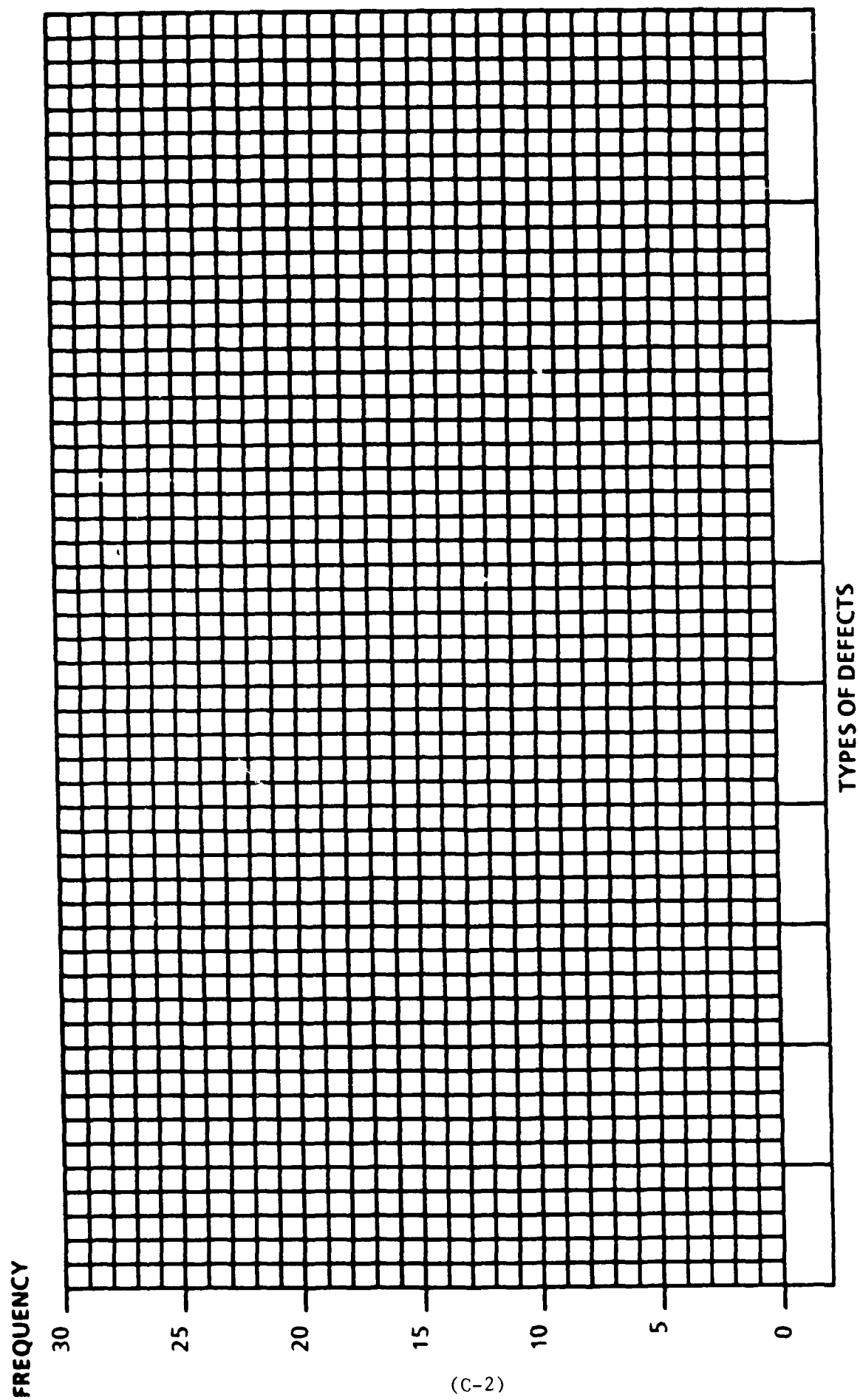


Figure C-1. Worksheet for plotting frequency of paint spraying defects.

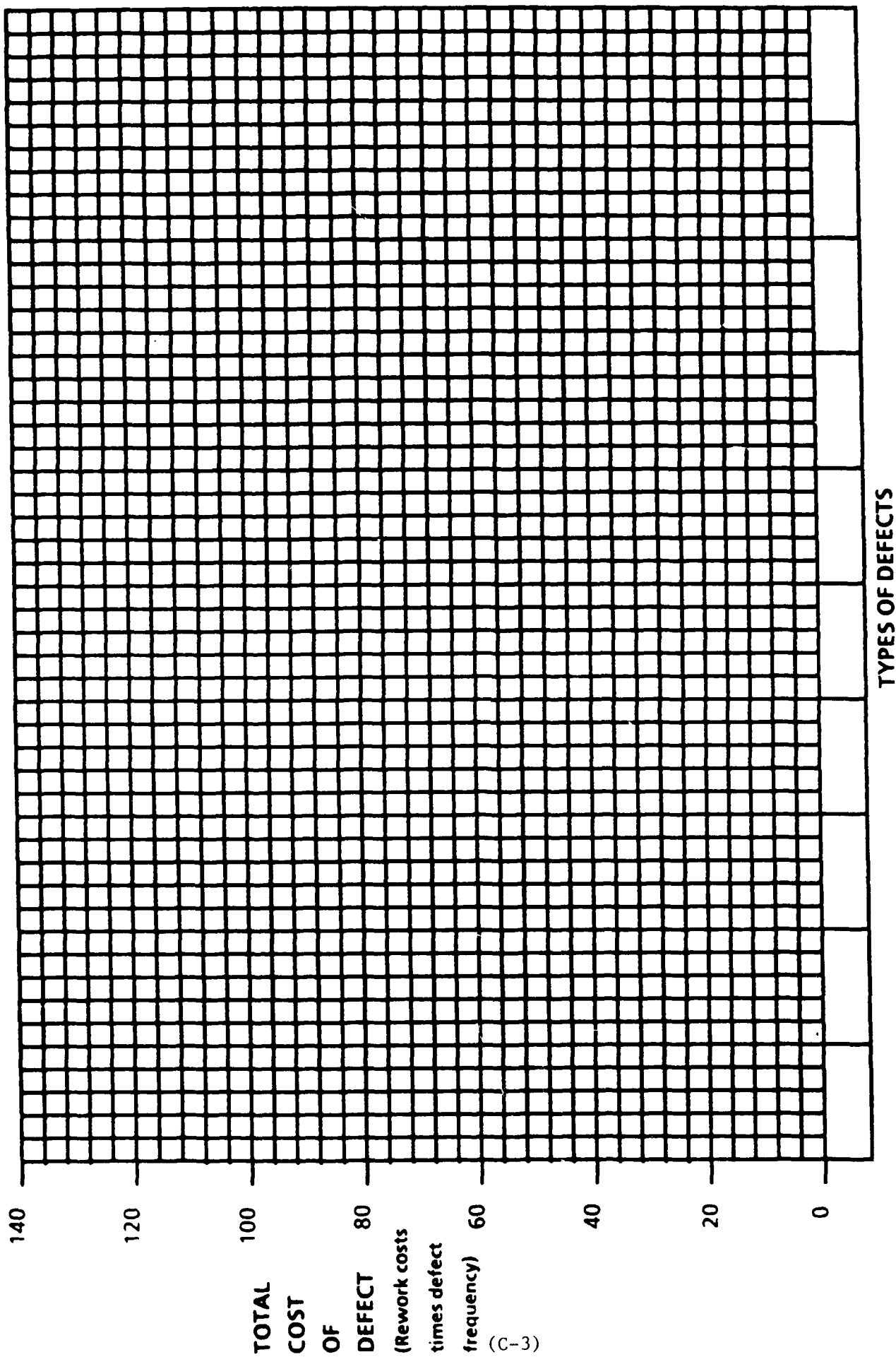


Figure C-2. Worksheet for plotting total costs of paint spraying defects.

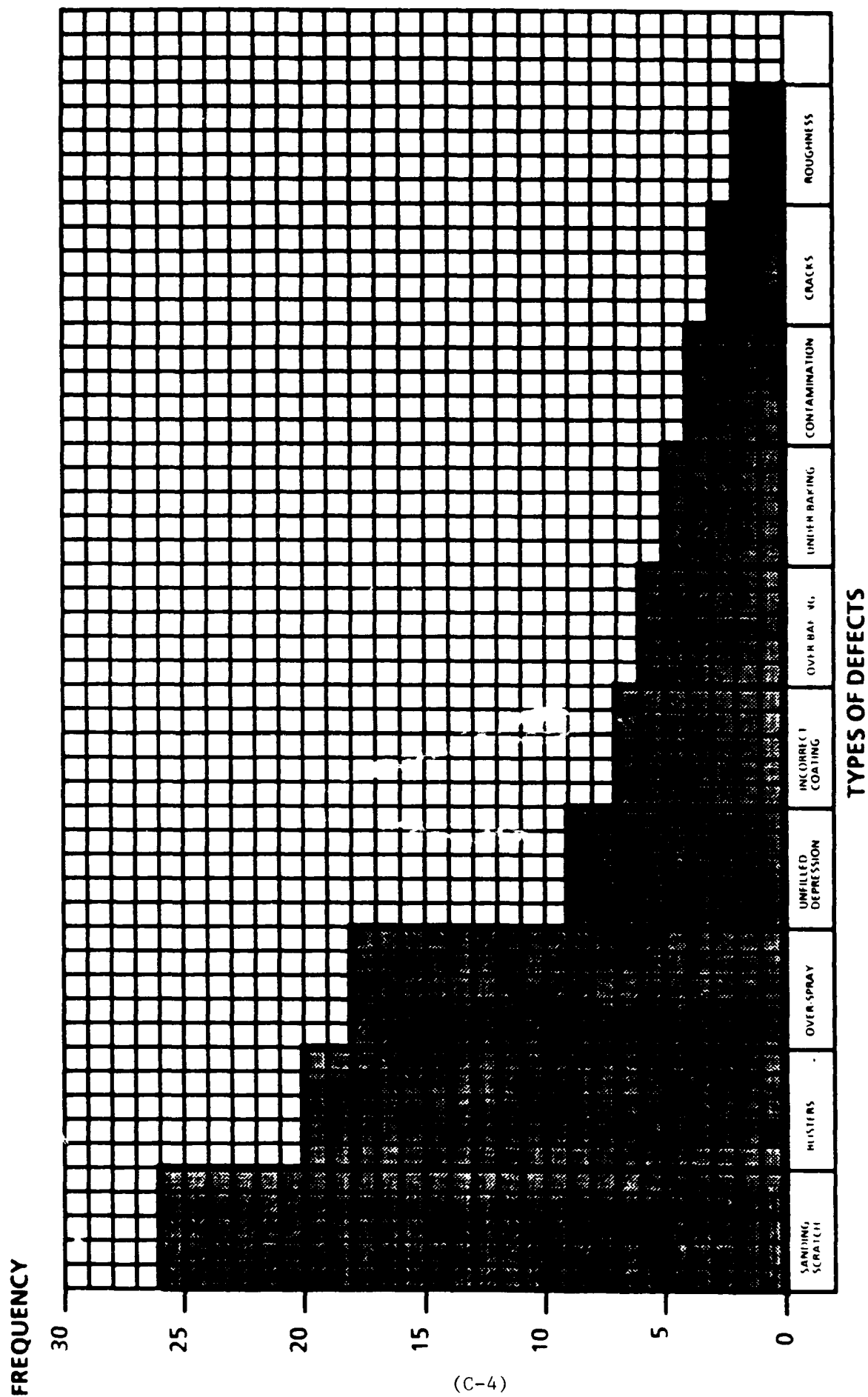
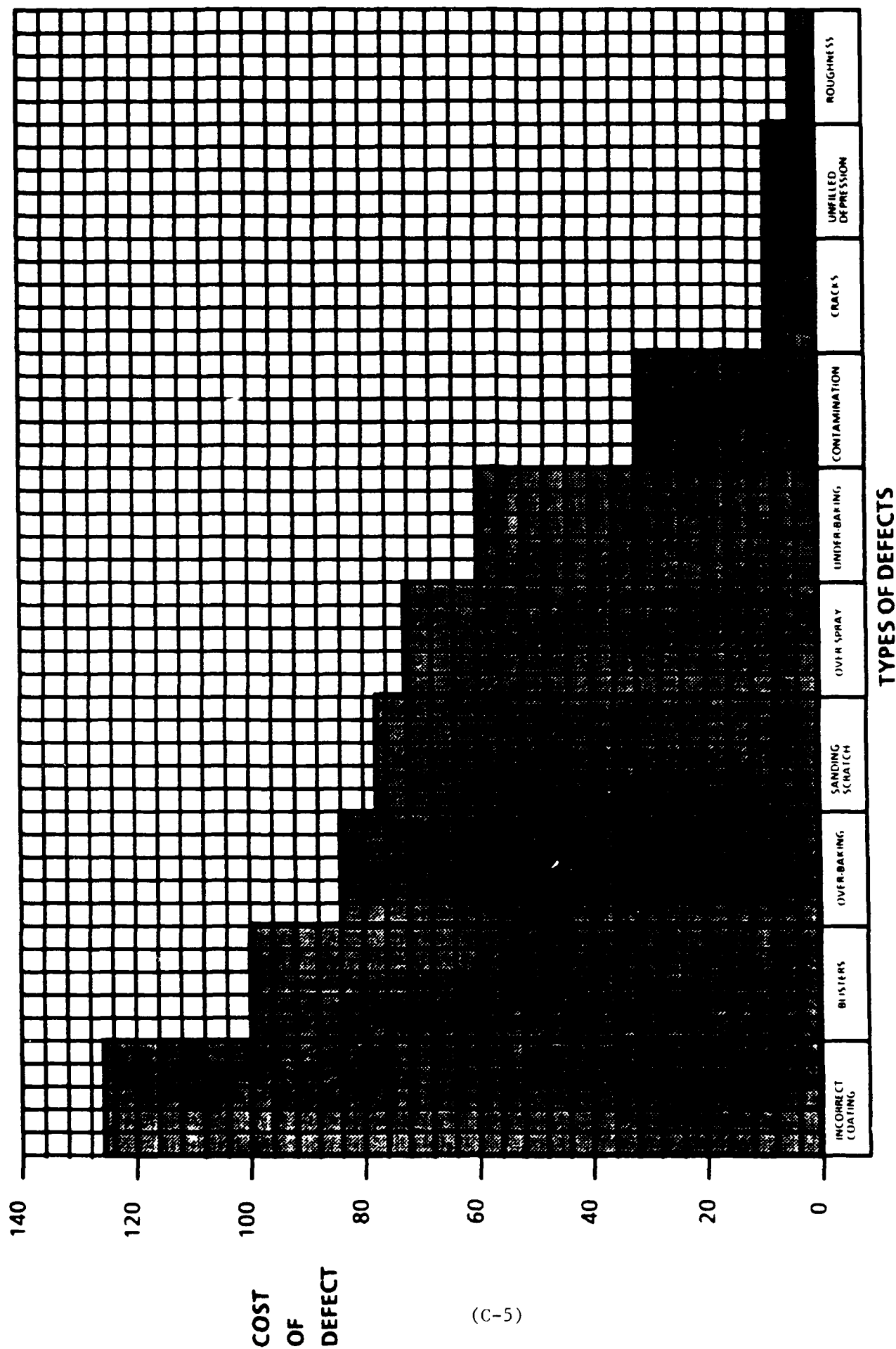


Figure C-3. Answer sheet showing how a Pareto graph can display the ranked frequencies of paint spraying defects.



(C-5)

V-93

Figure C-4. Answer sheet showing how a Pareto graph can display the ranked total costs of paint spraying defects.

APPENDIX D
TQM PROCESS IMPROVEMENT CASE STUDY FORMAT

(D-0)

V-95

TQM PROCESS IMPROVEMENT CASE STUDY FORMAT

Background: State problem addressed by the case study you are working on. Use information obtained from customers.

Current Performance: Give an overview of the quality, costs, and schedule performance of the process.

Improvement Goals: State goals of process improvement effort. Use outcome goals defined by the Executive Steering Committee.

General Process Steps: List major operations and decisions used in the process. Use general experience of Executive Steering Committee.

Groups Involved in Improvement Effort: Describe the composition of the Quality Management Board and the Process Action Teams who conducted the process analysis. Use records of Executive Steering Committee meetings.

Analysis of Process: Present and discuss findings of process analysis conducted by the Process Action Team. Include process-specific flowchart, Pareto charts, and cause-and-effect diagrams as needed.

Quality Characteristics and Related Process Variables: List the characteristics of the product or service that significantly affect its quality. Along with each characteristic, identify the process variables that were found to lead to the characteristic. Use the information obtained during the "Do" and "Check" phases of the process improvement model (PIM). Present SPC charts to illustrate relationships between the process variables and specific quality characteristics.

Process Improvement Actions: Describe the actions taken by the Process Action Teams and the Quality Management Boards on the process variables to meet the stated goals. Use the information obtained during the "Act" phase of PIM. List the improvement actions under their related quality characteristic. The following format is suggested.

Quality Characteristic: Name specific defect or feature of product or service.

Critical Variables: Name specific variable.

Action: Describe the steps taken to correct current problems and prevent future defects.

Evaluation of Process Improvement Actions: Summarize the results of the process improvement actions. Use the goals and baseline information obtained during the "Plan" and "Do" phases of PIM. Compare this information with the information obtained during the "Act" phase of PIM.

Requirements for the Long-term Maintenance of the Process Improvement Actions: Describe the process-specific and organization-wide support and resources required to permanently establish the process changes.¹

Personnel: Describe changes made in the work force involved in the process.

Methods: Describe changes made in the operations of the process.

Materials: Describe changes made in the supplies used in the process.

Machines: Describe changes made in the equipment used in the process.

Monitoring: Describe changes made in how process performance is measured.

Future Improvement Opportunities: This is an optional section. Use customer feedback information to describe new process improvement goals. Use information obtained during the process analysis described in this case study to identify different aspects of the process that should be improved.

¹ "Permanent" in the context of TQM means "until a better way of doing work is found and verified."

APPENDIX E
FICTITIOUS STUDY OF THE F/A-32 WOLVERINE
AIRFRAME REPAINTING PROCESS

(E-0)

V-99

FICTITIOUS CASE STUDY OF THE F/A-32 WOLVERINE AIRFRAME REPAINTING PROCESS

Background

The Mort de Mer Aviation Depot (MMAD), Point Loma, provides aviation maintenance and logistical services for the 13th Gyrene Aircraft Wing at Araphel Gyrene Corps Air Station. The Air Wing includes three F/A-32 Wolverine Squadrons, each with 12 aircraft. The F/A-32 is designed for use in low-intensity conflicts that require precision strikes in areas protected by extensive anti-aircraft systems. A major component of the F/A-32 defensive system is its distinctive "ghost rider" paint coating. This coating is radar-reflective and minimizes the possibility of early detection of the aircraft by hostile forces.

As part of MMAD's total quality management (TQM) efforts, organizational goals are determined through customer information. Members of the TQM Executive Steering Committee are responsible for obtaining customer information. During the gathering of such information, discussions with the Air Wing Commander and Wolverine pilots confirmed that the quality of the F/A-32 paint coating is a major factor in maintaining the combat readiness of the aircraft. Other customer concerns are the cost of painting the F/A-32 and delivery delays caused by paint defects.

Current Performance

The MMAD Executive Steering Committee conducted a review of archival information to determine current levels of quality, costs, and schedule performance (baseline data) associated with the F/A-32 painting process. Painting data for 1987 from the three Air Wing Squadrons were retrieved and analyzed. The following information about quality, costs, and schedule were found:

Quality

An average of 37 paint defects occurred per aircraft. Some defects were minor (surface roughness), but others were major (insufficient coating).

Cost

Fixing these defects cost \$8,000 per squadron, a total cost overrun of \$24,000 to the Air Wing.

Schedule

Analysis of labor transactions and delivery data indicated that correcting paint defects added an average of 3 days to the time required to complete the overhaul of an F/A-32.

Improvement Goals

The identification and removal of unwanted variation in the F/A-32 Wolverine painting process are expected to lead to fewer defects per aircraft, lowered processing costs, and improved turnaround time. The results of process improvement actions will be compared with the baseline data. By preventing defects in the F/A-32 painting process, there is a potential yearly cost savings of \$24,000. Reduction in the 3-day delay in turnaround time is expected to contribute to the combat readiness of the 13th Gyrene Aircraft Wing.

General Process Steps

The Executive Steering Committee developed a general process flowchart to aid in identifying critical management areas of responsibility in the painting process. The following chart presents the major operations required in the maintenance of the F/A-32 Wolverine (see Figure E-1).

Groups Involved in Improvement Effort

Based on a review of the process flowchart and its cumulative knowledge, the MMAD Executive Steering Committee chartered a Quality Management Board (QMB). The QMB was made up of seven divisions from Engineering, Production, Management Controls, Quality Assurance, Material, and Purchasing. It was given the responsibility of analyzing the output of the painting process to determine process areas for detailed investigation.

The QMB chartered a Process Action Team to identify specific process variables that affected quality. This team was comprised of paint shop artisans (Production) and individuals from the other divisions represented on the QMB.

Analysis of the F/A-32 Painting Process

The QMB reviewed quality control and budget records to identify the defects that had a major influence on painting quality and rework costs. Ten types of painting process defects were analyzed through the use of Pareto analysis:

Blisters (Blis)--raised portions of finish coat

Contamination (Con)--dirt, etc., in coating

Cracks (Crck)--breaks in finish coat

Decal misplacement (Dec)--squadron insignia placed on
wrong aircraft or in improper location

Unfilled Depression (Ufd)--dents in surface

Insufficient coating (Coat)--not enough coating to
provide adequate radar protection

Over-spraying (Ovsp)--paint or primer on unwanted
surface

Roughness (Rgh)--sags or runs in coating

Sanding scratches (Scr)--marks due to excessive
abrasion

Under-baking (Unbk)--insufficient heat or time in
drying oven

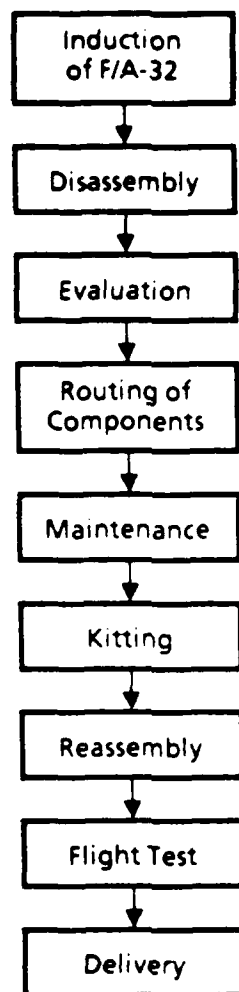


Figure E-1. General F/A-32 maintenance process flow.

As cost was a critical customer concern, the defects that were the most expensive to correct were targeted for the first improvement efforts. Based on the Pareto analysis these defects were: insufficient coating, blisters in the paint surface, and cracks (see Figure E-2).

The Process Action Team developed a flowchart describing the painting process (Figure E-3). This chart describes the process as it actually operated and was compared with existing instructions and operations documents. Very little was found in the way of formal documentation. Apparently, the F/A-32 painting process had been developed and maintained informally. The current flowchart of the painting process will be used in future efforts to streamline and standardize operations.

F/A-32 Painting Quality Cause-and-Effect Analysis

The Process Action Team developed a cause-and-effect diagram to identify process variables that could affect the quality of F/A-32 painting (Figure E-4). The information shared during the construction of the diagram was valuable in directing the Process Action Team's efforts to begin preliminary data collection. The next section presents the quality characteristics and process variables that were found to be critical in the process.

Quality Characteristics and Related Process Variables

The Process Action Team used scatter diagrams to identify the process variables that had the greatest effect on the quality problems associated with the F/A-32 painting process. The findings of the Process Action Team have been organized by quality characteristic.

Quality Characteristic: Insufficient coating.

Related Process Variable: Air pressure of paint sprayer (Figure E-5).

Quality Characteristic: Blisters in the paint surface.

Related Process Variable: Contamination in filler for surface depressions (Figure E-6).

Quality Characteristic: Cracks.

Related Process Variable: Temperature of paint baking oven (Figure E-7).

Interpretation of the scatter diagrams supported the belief that cause-and-effect relationships existed among the variables and the quality characteristics. The next section presents the general actions taken to improve and control process performance.

COST OF DEFECT

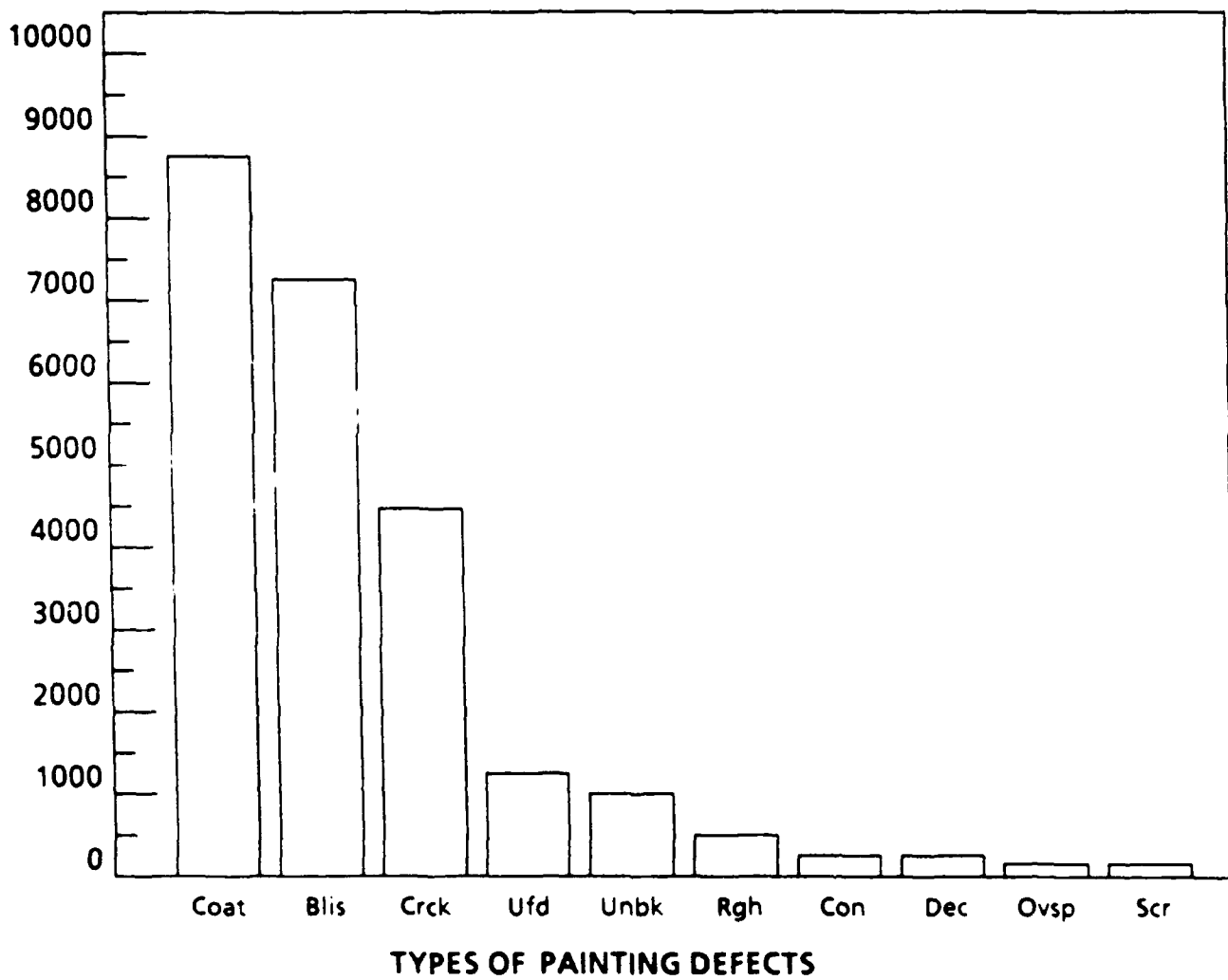


Figure E-2. F/A-32 painting defect costs for 1987.

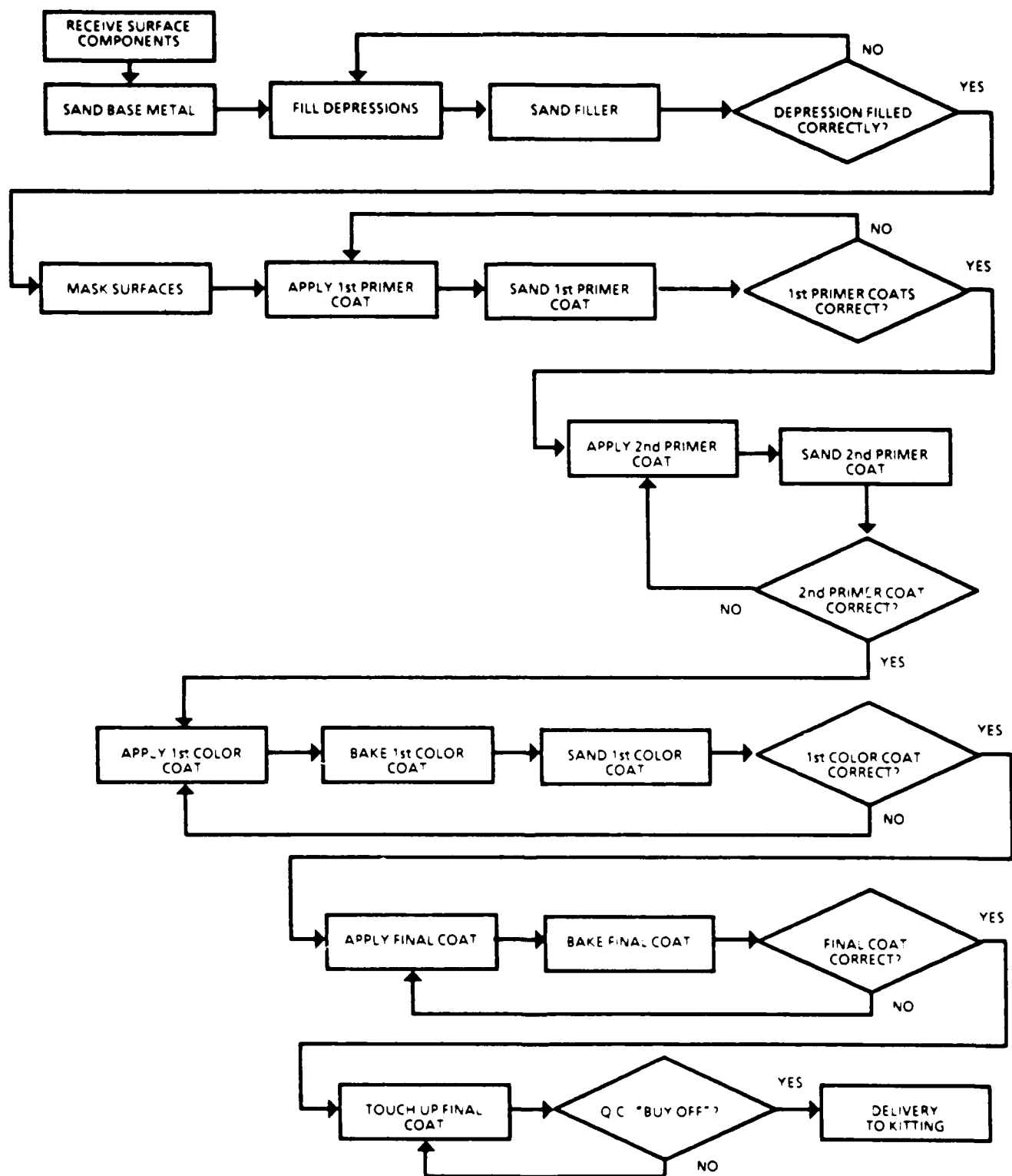


Figure E-3. F/A-32 painting process flowchart.

(E-6)

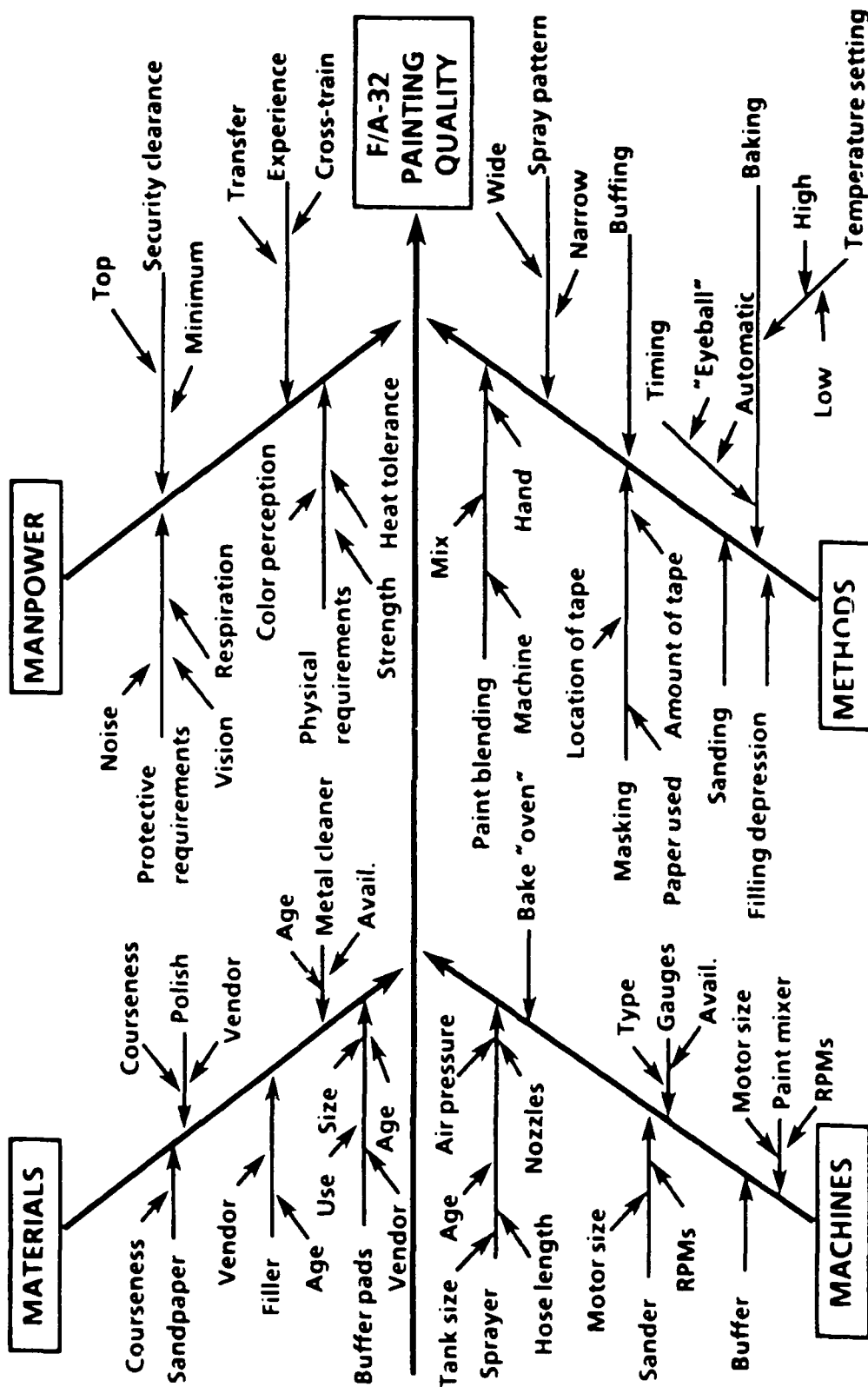


Figure E-4. Cause-and-effect diagram developed by the Process Action Team.

Coating Thickness (in mm)

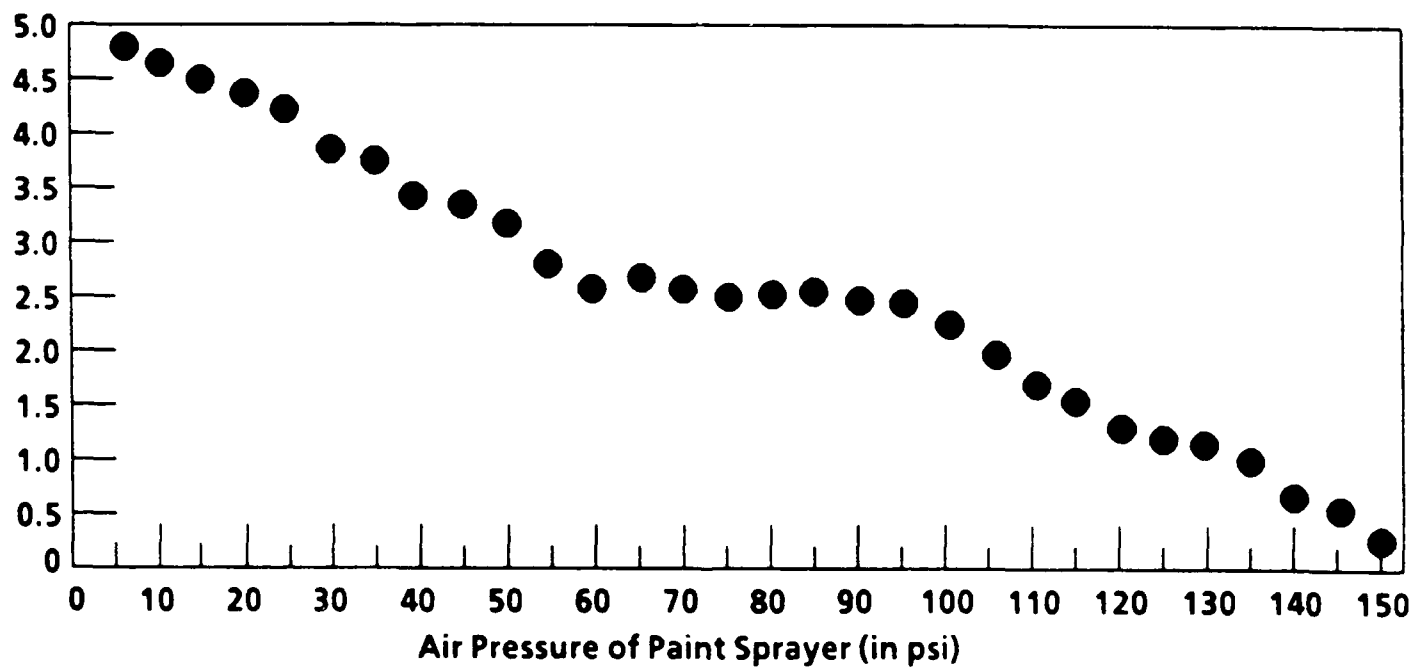


Figure E-5. Air pressure of paint sprayer and thickness of painting coating.

of Blisters per square yard

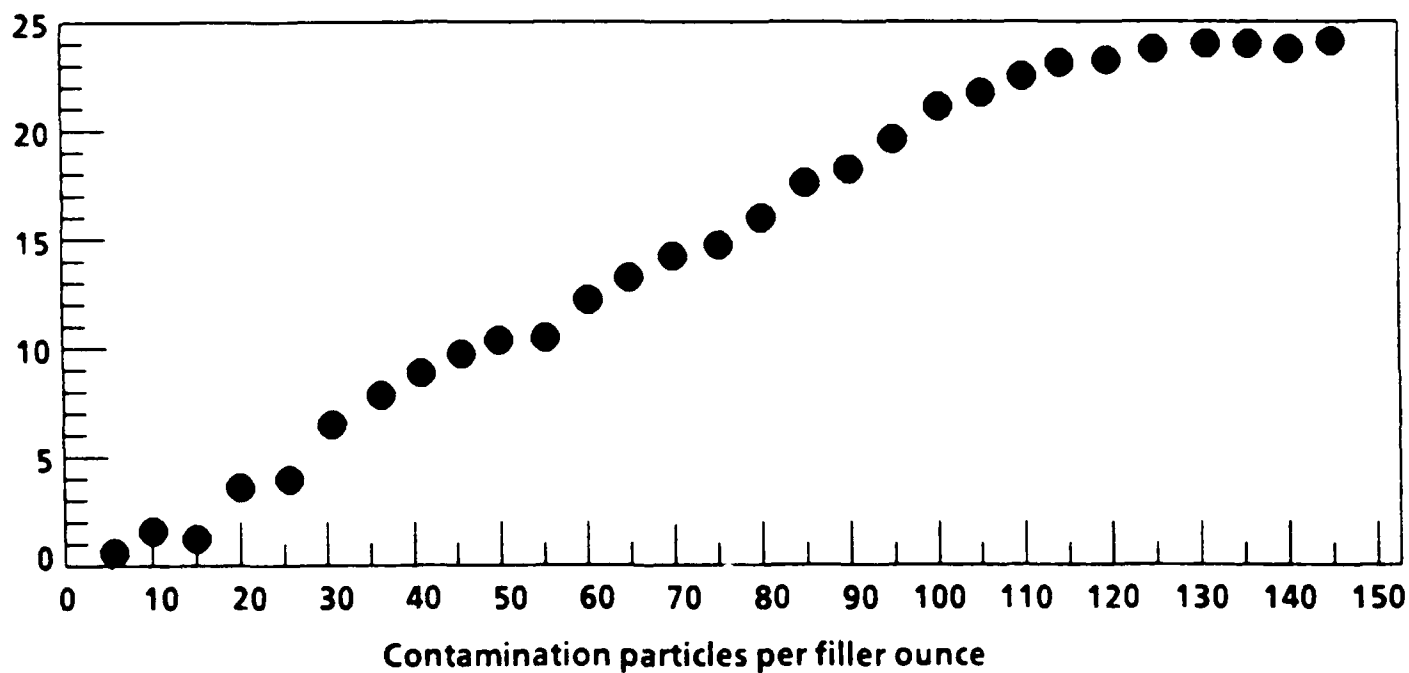


Figure E-6. Depression filler contamination and number of blisters per square yard.

Cracks per square foot

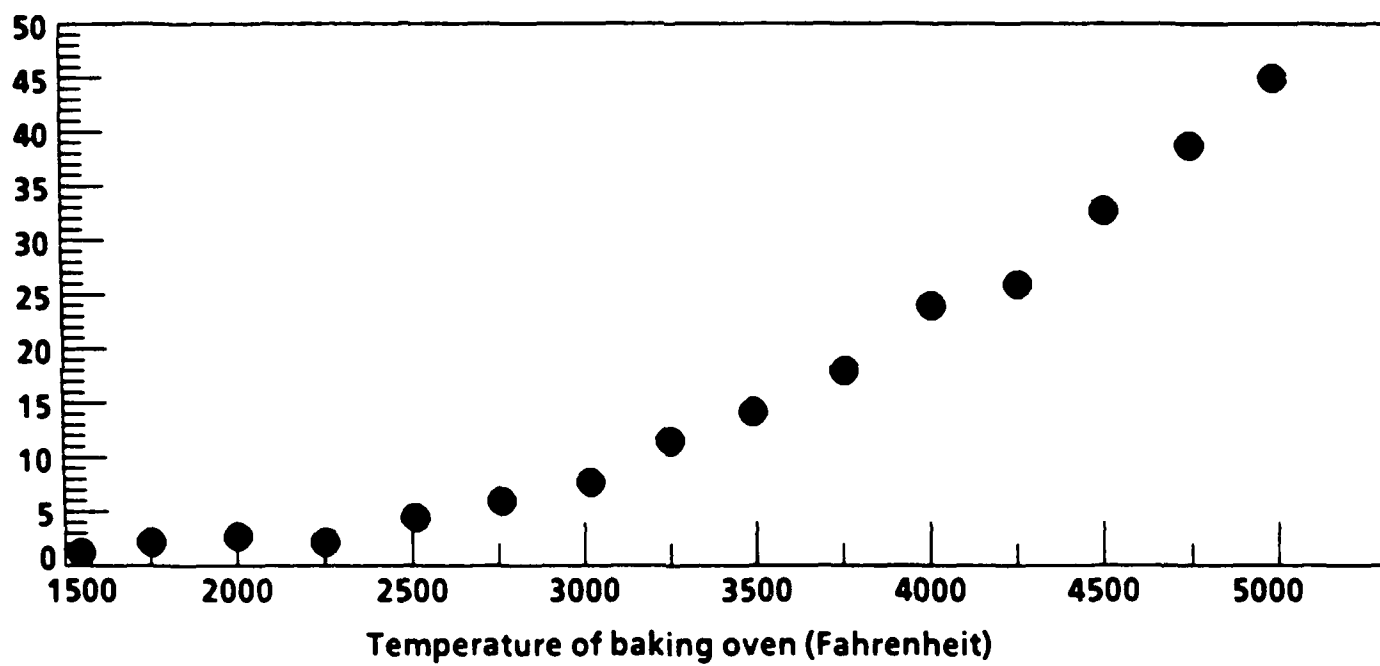


Figure E-7. F/A-32 paint coating cracks and relationship to oven temperature.

Process Improvement Actions

Based on the information provided by the Process Action Team, the QMB and the ESC took corrective actions. These actions have been organized according to their related quality characteristics and critical variables.

Quality Characteristic: Insufficient paint coating.

Critical Variable: Air pressure of paint sprayer.

Action: Chronically under- and over-pressurized sprayers have been replaced. Regular maintenance of sprayers has been established to ensure more consistent air pressure. Air pressure data will be collected on a sampling basis at the floor level by workers.

Quality Characteristic: Blisters.

Critical Variable: Filler contamination.

Action: Air-tight containers for filler material have been installed in the preparation areas. Workers have been shown the relationship between filler contamination and paint blisters (Figure E-6). Purchasing will order filler from the vendor that has the best quality. All vendors have been informed by Purchasing of quality requirements and the TQM approach. Quality of incoming filler material will be monitored by workers at the receiving area. Purchasing will be given information on vendor performance on a regular basis.

Quality Characteristic: Cracks.

Critical Variable: Oven temperature.

Action: Oven thermostats have been reset to ensure the optimum bake setting. Oven tenders have been instructed to use actual oven temperature instead of relying on time in oven to determine bake. The QMB has begun looking for heat monitors that are more accurate and easier to read than the currently used ones.

Evaluation of Process Improvement Actions

Evaluation data were collected on the painting of the aircraft in the three squadrons. The effects of the process improvement actions on the quality, cost, and schedule of the F/A-32 painting process are presented below.

Changes in quality: The average number of paint defects per aircraft dropped from 37 to 19.

Changes in cost: Overexpenditures due to paint defects decreased by \$6,000 per squadron. This has resulted in a total cost savings of \$18,000 to the 13th Gyrene Aircraft Wing.

Changes in schedule: Delays resulting from the correction of paint defects have been reduced from an average of 3 days to an average of 1.6 days.

Requirements for the Long-Term Maintenance of Process Improvements

Personnel

Based on the findings of the F/A-32 painting Process Action Team, training in machine settings and use will be given to paint shop workers. Those paint shop workers who were not part of the Process Action Team will also be given instruction in SPC methods so they can help monitor the process.

Methods

Written instructions will be developed on the optimum machine settings and painting methods.

Materials

Purchasing has been authorized to buy air-tight containers for filler material.

Machines

A new, regular schedule of preventive maintenance has been authorized for paint sprayers and baking ovens.

Monitoring

Control charts have been established to monitor the performance of the following critical process variables within the F/A-32 painting process.

- Paint sprayer air pressure
- Filler contamination
- Oven temperature

These control charts will be maintained at the floor level. Workers will collect process data on a sampling basis.

Future Improvement Opportunities

Process monitoring and improvement efforts will be continued on the three quality characteristics identified by analysis. The problems of unfilled depressions and under-baking will be addressed in upcoming process improvement efforts. The QMB is investigating the possible use of new painting technologies, such as microwave baking and electrostatic paint application.

SECTION VI: THE EFFECT OF REWARD SYSTEMS, COOPERATION, AND COMPETITION ON PEOPLE, QUALITY, AND PRODUCTIVITY

(A debate between Alfie Kohn, author of No contest: The case against competition [Houghton Mifflin, 1986] and Tom Peters, whose most recent book is Thriving on chaos: Handbook for a management revolution [Knopf, 1987]).

Kohn, A. (November 1987). No contest: Contrary to what you may think, your company will be a lot more productive if you refuse to tolerate competition among your employees. Inc., pp. 145-146.

Peters, T. (November 1987). Letter to the editor: Incentives and competition deserve real cheers, says the guru of excellence. Inc., pp. 80-82.

Kohn, A. (April 1988). The author replies and refuses to back down. Inc., p. 83.

This series of articles from Inc. is a sample of the ongoing debate among organizational scientists and management theorists about the effect of contemporary management practices on human performance, and, more fundamentally, about human nature.

Among the issues addressed are the benefits or harmful effects of competition and cooperation and the merits or destructive tendencies resulting from the use of various types of rewards and incentives in organizations.

Kohn's arguments are based on his review of the research findings of social psychologists and sociologists. Together, these findings provide a strong argument that competition has many harmful effects on children, adults, and on society. The idea that competition is good is strongly challenged. The research findings seem to indicate that cooperative, not competitive behavior, is natural and beneficial to human beings.

MANAGING PEOPLE

NO CONTEST

Contrary to what you may think, your company will be a lot more productive if you refuse to tolerate competition among your employees

BY ALFIE KOHN

You've probably met the sort of chief executive officer who does an uncanny impersonation of Vince Lombardi: "Winning isn't everything—it's the only thing." The more competition there is among his staff, he figures, the better for his company.

It's different in your office. You've heard about team building and Theory Z, and you don't go out of your way to promote rivalry. Of course, some of your managers do vie with one another—for bonuses, perhaps, or power, or your approval. And your salespeople certainly aren't strangers to the race to be number one. But no harm in that, right? Isn't competition a productive force if used in moderation?

I've been studying the subject for the past five years, weighing the research from many different fields to assess the effects of competition. My conclusion is that optimal productivity not only doesn't require competition; it appears to require its absence. The ideal amount of competition in your company is none at all. Your best bet is to discourage any informal competition that may develop, and to go out of your way to design cooperative work groups and incentive systems.

Notice that I'm not just warning against excessive or inappropriate competition. I'm saying competition itself—which simply means requiring one person or group to fail in order that another can succeed—is *inherently* counterproductive. Similarly, I'm not offering a "soft" argument against competition, basing my objection solely on its destructiveness to us as human beings. I'm saying that competition also makes no sense from the perspective of the bottom line. It holds people back from doing their best.

Dean Tjosvold, a professor of business administration at Simon Fraser University, in British Columbia, has been turning out one study after another comparing cooperation with competition. "Coopera-

tion makes a work force motivated and entrepreneurial," he concludes, whereas "serious competition undermines coordination."

In one of those studies, completed last spring, 47 managers at a company that distributes and maintains heavy equipment filled out detailed questionnaires. They indicated the extent to which their workplace promoted cooperation or competition, and also how effective they believed their subordinates to be. Meanwhile, 143 of these subordinates were assessing the styles of the managers. When the results were tallied, it turned out that the effectiveness of supervisors and subordinates alike went hand in hand with a cooperative orientation. Effectiveness was also shown to be negatively related to competitiveness.

In another study, this one of managers at an engineering-consulting firm and employees of a utility company, Tjosvold asked for descriptions of significant corporate events—one success story and one tale of woe. He found a strong correlation between experiences of effectiveness and a perception of cooperation. Likewise, he found "competitive goals were related

to ineffective interaction, negative feelings, little progress, and weakened relationships."

One reason that cooperation is associated with better performance is that employees enjoy this arrangement more. When Tjosvold and his colleagues interviewed 310 medical laboratory technicians from 10 different hospitals, once again the results were straightforward. Technicians were satisfied with their jobs and inspired to work hard if their supervisors were judged to value cooperation in the workplace. Those who worked in a competitive atmosphere were dissatisfied and, in many cases, thinking about quitting.

The father of this kind of research is sociologist Peter M. Blau, whose classic 1954 study compared two groups of interviewers at a public employment agency. Those in the first group competed fiercely to fill job openings. In the second, interviewers worked cooperatively, making sure to tell one another whenever a new position opened up. And it was the latter group that filled significantly more jobs.

Blau's thoughts on why this happened are worth noting. In the competitive environment, each agent hoarded job notifications rather than posting them so his or her colleagues could see them. This practice eventually was used defensively and thus became self-perpetuating. The members of the cooperative group, on the other hand, freely exchanged their resources and skills. What's more, they didn't have to worry about the hostility and distrust that competition can breed. "Social cohesion" means better results, Blau concluded.

Then there is the matter of anxiety. Blau and other researchers have found that the pressure produced by having to defeat others—and risk being defeated—can interfere significantly with performance. It is true that a small amount of anxiety may be stimulating, but the stress



of competition typically has the opposite effect.

One study of college students, conducted by W. J. McKeachie and the late Donald Bruce Haines, found that those who were in competitive discussion groups—informed that their grade would depend on how their answers compared with others—“became more anxious . . . and found themselves losing self-assurance.” These students weren’t able to cover as many questions as their counterparts, whose grades reflected how well the whole group did.

Such research supports the anecdotal evidence I’ve gathered while traveling around the country to talk about competition. A salesman in California told me his colleagues were “dropping like flies” when they had to best each other’s sales records. As soon as the system was changed to a noncompetitive quota, satisfaction shot up—and so did sales. An artist in Illinois observed that when he thinks about competing for exhibitions or prizes, he “get[s] all tight” and is unable to paint well. (Indeed, a 1982 study by Brandeis University psychologist Teresa M. Amabile showed that children who competed against one another produced much less creative collages than those who didn’t have to compete.) A Washington, D.C., restaurateur reported that after he eliminated all competition among his employees, he had never seen a group of happier or more productive workers.

But the problem with competition goes beyond the increased anxiety or the inability to share one’s talents. There is also the fact that victory and excellence are simply two very different ideas. They’re even experienced differently. To focus on winning, on beating out a colleague, is often to divert attention from the work itself. Getting optimal performance from your managers depends on making sure they find their work satisfying and challenging in its own right—not on turning their work into a means toward some external goal, such as being number one.

Even when the desire to push oneself to succeed isn’t grounded in intrinsic interest—being in love with the challenge itself—it doesn’t have to come from trying to defeat someone else. It can be based on comparing one’s performance with some absolute standard or with how one did last year. It also can be inspired by the gratification of working with others. In any case, competition is at best unnecessary and at worst a serious impediment to quality work.

When that work involves learning skills and absorbing information, competition proves to be particularly unproductive. In 10 separate studies, David W. Johnson and Roger T. Johnson, professors of education

at the University of Minnesota, have weighed the benefits of competitive and cooperative approaches. The results: cooperation promoted higher classroom achievement in 21 of the studies, while 2 had mixed results and 3 found no significant differences.

These studies involved different academic subjects, different ages of students, and different ways of testing how well they had learned. Competition consistently interfered with achievement, but the effect was strongest when the tasks were more challenging. The Johnsons observed that “higher quality cognitive strategies for learning” were used by students working together. Compared with those who competed against one another, they could come up with clever ways to sort information, find solutions, and avoid duplication of effort.

Better performance was not the only advantage of cooperation, the Johnsons

I’m saying that competition makes no sense from the perspective of the bottom line. It holds people back from doing their best.

found. Freed from the pressure of having to beat one another, students developed higher self-esteem. Their enjoyment of the subject matter increased, and they came to accept one another more readily—even those with different backgrounds and abilities. These findings, of course, have profound implications for the workplace.

But cooperation means more than just talking a good game. Circulating a memo to remind employees that “we’re all in this together” is useless. What’s required is to structure cooperation by creating what social scientists call “positive interdependence,” where members of a group depend on, and are accountable to, one another. In practice, that means all group members work for the same goal, use the same resources, and receive the same reward. The shared group identity that results is a powerful motivator because one person can succeed only if the others succeed, too. (In an individualistic workplace, other people’s success is irrelevant to one’s own. In a competitive workplace, the only stake one has in others’ performance is a desire to see them fail.)

Keep in mind also what cooperation doesn’t mean.

It doesn’t mean everyone thinks alike or that no one ever argues. Conflict is both inevitable and desirable: disagreement

produces change and challenges mistaken decisions. The question is not whether conflict will exist, but whether it will take place in the context of competition, where people are trying to score points and beat one another, or in the context of cooperation, where everyone has the same goal of reaching the best possible solution.

Cooperation doesn’t mean altruism. It refers to a structure in which employees sink or swim together. Each has a built-in incentive to work with the others—not to help them at his or her own expense. Also, it doesn’t mean having teams compete against one another. Competition among groups, as among individuals, is both unnecessary and undesirable. It closes off the possibility of sharing ideas and resources with others in the company. After reviewing dozens of studies, the Johnsons concluded that “cooperation without

Competition among groups, as among individuals, is undesirable. It closes off the possibility of sharing ideas and resources with others in the company.

intergroup competition [may promote] higher achievement and productivity than cooperation with intergroup competition.”

Finally, cooperation doesn’t rule out bonuses and incentive plans. In moderation, these can be effective motivators—providing they are *never* offered as prizes that only one person or group can win. As soon as that artificial scarcity is created—as it is by teachers who grade on a curve—no rational person will want to help anyone else. The result is ill will and, in the long run, declining productivity. Any team that reaches a certain goal should be eligible for the bonus.

Of course, not all competition can be eliminated immediately. The race for promotion results partly from the pyramid-like structure that defines most American corporations. Competition among corporations, meanwhile, is, for better or worse, central to our economic system. But other sorts of rivalry can be ended with surprisingly little effort. The research is overwhelmingly clear that it makes sense to do so. □

Alfie Kohn is a lecturer and writer in Cambridge, Mass. He is the author of No Contest: The Case Against Competition, recently published in paperback by Houghton Mifflin, which received the American Psychological Association’s 1987 National Psychology Award.

Letter to the Editor

Inc., 38 Commercial Wharf, Boston, MA 02110.

Incentives
and
competition
deserve
real cheers,
says the
guru of
'Excellence,'
not
the Bronx
variety
they received
in these
pages three
months ago

BY
TOM PETERS

A RECENT *NEW YORKER* CARTOON pictures a blackboard bursting with obscure mathematical formulations. One scientist, looking at the board, says to a colleague, "Oh, if only it were so simple." I couldn't help recalling the cartoon as I read Alfie Kohn's article in the January issue of *INC.*, "Incentives Can Be Bad for Business."

Kohn clearly knows his field. From an academic perspective, his article is superb. He musters compelling evidence to argue that—on the production line or in the research lab—workers will respond most creatively if they have a sense of autonomy, on the one hand, and if they value a task or a job for its own sake, on the other. He is

saying that intrinsic motivation is the key to high performance, and I certainly agree.

Kohn further argues that companies can undermine worker creativity by providing the wrong incentives—if, say, they put too much emphasis on extrinsic rewards, such as money, prizes, and positive feedback. These kinds of incentives, he says, lead employees to focus

on performance that is quick, riskless (that is, noninnovative), and geared strictly toward volume of output. If a company does use incentives, Kohn recommends that they emphasize quality of output, rather than quantity, and that they encourage self-control (that is, innovation and risk taking). For similar reasons, Kohn argues against establishing a competitive environment in a company. He particularly abhors contests in

which some people get no reward because other individuals or groups did better.

On a point-by-point basis, I have no quarrel with any of Kohn's arguments. Moreover, I find him to be a thorough student of the arcane experimental literature on social psychology. But when it comes to the real world of business, I worry that he leaves the wrong impression on a number of scores.

Positive reinforcement is better than negative. Kohn does a nasty disservice to Harvard psychologist B. F. Skinner by portraying him as a mindless advocate of "waving dollar bills in front of people." To be sure, Skinner is the popularizer of positive reinforcement, but Kohn ignores his most important finding, one with huge implications for business, namely: positive reinforcement is much more beneficial than negative.

That's a key oversight because negative reinforcement (criticism) is far and away the most common means by which American companies try to influence performance. They constantly tell people what they did wrong, rather than what they did right. Yet, as Skinner showed, negative reinforcement—even if well intended—seldom leads to improved performance. More often, it produces a) convoluted efforts to hide negative results and b) risk-averse behavior to a much greater degree than that which Kohn decries when criticizing the excesses of positive reinforcement.

Anyone who has spent time observing real-life business practices knows that Skinner is absolutely right on this point. The great quality advocate, W. Edwards Deming, a statistician who has little truck with psychologists, is adamant in his agreement. He has said that the American propensity for negative performance appraisals is our number-one management problem. Nor is he being totally facetious when he contends that it takes half a year for the average manager to recuperate from his or her performance review.

And, by the way, Skinner would be the first to agree with Kohn that "surprising" positive incentives work best. Skinner, after all, was the one who discovered that aperiodic (random, unexpected) "schedules of reinforcement" are much more powerful shapers of future behavior than periodic (routine, expected) schedules.

Business problem number one is the almost total absence of positive reinforcement. Although Kohn is correct about the pitfalls of positive reinforcement, he is arguing in a vacuum. If only American business were having trouble because of too much emphasis on extrinsic motivation, resulting in the denigration of intrinsic motivation. Unfortunately, the much larger problem is the almost total absence of positive reinforcement in the average U.S. company, regardless of size.

Consider these two anecdotal, but typical, examples. One involves Sam Preston, a recently retired executive vice-president at S.C. Johnson

**Our problem isn't
overemphasis on
incentives; it's that
so few companies
offer them at all.**

& Son Inc., which makes Johnson Wax among other products. Throughout his career, Preston would look for positive acts by employees. Whenever he stumbled on one, he would pen a quick note to the person responsible, concluding with the initials "DWD." Eventually, the recipients figured out that "DWD" stood for "Damned Well Done." When I met Preston, he had just finished his round of retirement parties, and he spoke of his amazement as person after person came up, occasionally verging on tears, to thank him for a single "DWD" that he'd sent as much as 15 years earlier.

I heard a similar story from a man who had recently bought a quarry in New England. Upon learning that a certain quarryman had cut an extraordinary amount of rock the day before, the new owner had impulsively grabbed a walkie-talkie to offer congratulations and praise. Shortly thereafter, he was talking to another employee and learned that the quarryman had been on cloud nine for days. Turns out that this stellar, 25-year veteran of rock blasting had never before received a word of praise from the boss.

The plain fact is that, in America, workers and managers receive far too little positive reinforcement for their contributions. The average employee faces a daunting array of hurdles and uncertainties. Simply to make it through the day is often worth a "well done." But that average person is not likely to receive even a doff of the cap from year to year, or decade to decade, let alone day to day. On a personal note, I must admit to Mr. Kohn that, despite having achieved a modicum of acclaim, I myself can never get enough of that wonderful stuff called positive reinforcement—and if you must schedule your applause in advance, it's jolly well fine with me.

Positive reinforcement need not be quantity based. Kohn cautions against rote behavior stemming from positive reinforcement, but the real source of rote behavior is excessive attention to volume. What gets measured gets done, as the saying goes, and—at the vast majority of companies—what gets measured is volume. What gets overlooked is quality. The operative phrase is: "Don't improve it; ship it." That's a big problem, but what else can we expect when volume is all that we try to measure?

The solution, however, is not to abandon incentives, but to base them on nonvolumetric factors as well. In this regard, I was delighted to learn recently that First Chicago Corp. is giving some of its managers bonuses based in part on their success in meeting certain "minimally acceptable performance" goals, as determined by customers.

Similarly, it was quality of service that helped Phil Bressier establish himself as Domino Pizza's top franchisee in the important category of repeat business. Each of his stores would give out a volume-based award for best driver. Before the award was made, however, customers were asked to evaluate the driver's performance. If

the quality of service didn't measure up, then no award.

The point is, there are ways to measure what was once thought to be unmeasurable. You can keep score on quality, customer service, responsiveness, innovativeness, even customer listening. Moreover, the sheer act of keeping score will provide a positive stimulant to improvement. Job number two, I'd agree, is to get the right balance between intrinsic and extrinsic motivational factors, but first let's put some of these other missing indicators on the map.

And then there is the little matter of equity, or share and share alike. It's not easy to develop a good incentive system, and there are undoubtedly thou-

sands of ways to construct useless, even damaging, ones. To read Kohn's article, you might think that bad incentive systems are the rule at most companies. The truth, however, is that most companies don't offer any incentives at all to their employees, except to a thimbleful of folks at the top.

A year and a century ago, in 1887, William Cooper Procter, president of Procter & Gamble Co., said that the chief challenge of big business was to shape its policies so that each worker would feel he was a vital part of his company with a chance to share in its success. P&G's landmark profit-distribution plan divided profits between the company and its workers in the same proportion that labor bore the total cost. If wages were 50% of costs, the workers' bonuses would be a whopping one-half of profits. Sadly, P&G's example was not widely emulated, and today only 15% of the U.S. work force participates in such a profit-distribution or gain-sharing plan. A paltry 10% own stock in their companies, despite the generous ESOP incentives available since 1974.

The significance of this appalling record was suggested by a survey that Daniel Yankelovich conducted in the early 1980s. U.S. and Japanese workers were asked to agree or disagree with the statement, "I have an inner need to do the best I can, regardless of pay." The U.S. workers, maligned by so many (especially their managers), outscored the Japanese. Then the two groups were asked a much more practical question: Who did they think would benefit most from an increase in worker productivity? This time, the tables were turned. Some 93% of Japanese workers thought that they would be the prime beneficiaries, while only 9% of the Americans felt that way. In other words, Japanese workers believe that increased productivity is a matter of self-interest—and the facts support them.

So Kohn may be right about the pitfalls

**The fact is that
most employees go
year to year
without getting a
word of praise.**

of incentive systems, but he's dead wrong in suggesting that bad incentive systems are a major problem for American business. The far greater—and more commonplace—sin is to ignore the worker's incremental contribution altogether.

Competition is still the spice of life. The ancient philosopher's line is that the world would have no beauty without contrasting ugliness. For

better or (sometimes certainly) for worse, comparison—which is to say, competition—is the chief motivator for individuals and groups, whether it takes place in teen beauty pageants, among Nobel-level scientists, or on the shop floor.

Now competition can go too far. I agree with Kohn that competition may cause a worker to focus excessively on

speed and what the guy next to him is doing, thereby losing sight of the intrinsic value (that is, quality) of the task at hand. I have seen the disastrous consequences of basing incentive pay on work group competition—especially when workers are not trained adequately, and when the company does not provide the time, the place, and the tools to work creatively on individual and team improvement.

On the other hand, I have also seen group competition work wonders in a plant, under the right conditions. Look at New United Motor Manufacturing Inc. (NUMMI), the extraordinary joint venture between General Motors and Toyota. Its predecessor, a GM plant, was at the bottom of the heap in terms of productivity, quality, absenteeism, and numerous other performance indicators. Now, the 2,500-person operation scores at the top. The dramatic turnaround is mainly a result of employee involvement. Every worker is trained in at least a half-dozen jobs; each person must be good enough to train his or her colleagues; fellow hourly workers are team leaders; and the company provides all the training, tools, time, and space required for problem solving. Competition among teams is sky high, on the job and off, but meticulous preparation came first.

But, group competition aside, I think Kohn is focusing on a secondary issue here. We face enormous business problems today, and they were not caused by too much competition. Rather they reflect the broad deterioration of the national economy—a consequence of the virtual absence of competition from World War II until about 1965. During that period, almost all of our major industries became tidy oligopolies, in no shape to compete with anyone.

Kohn decries the ill effects of copying, and too

much distraction with competition. I submit that it is far worse to ignore the competitive reality, and to refuse to copy at all. Consider the Ford Taurus, one of the biggest American product successes in decades. For years, Ford had systematically ignored or denigrated Japanese automobiles and, to some extent, European ones as well. In developing the Taurus, however, it did a complete about-face, purchasing hundreds of vehicles from around the globe. Following a copy-and-exceed strategy, Ford set out to best those vehicles on hundreds of features, from the inner workings of the engine to the ease of gas cap removability. That is, of course, precisely the strategy for which we once scorned the Japanese. Ironically, it is the same strategy with which the Americans (and then the Germans) surpassed the British in years gone by. The process may not be as creative as Kohn would like, and it certainly reflects an obsession with competition. But it works. And its success demonstrates once again that we have far more to fear from too little than from too much competition.

Let me just add a personal note in conclusion. Many years ago, I was a Ph.D. student of management, and I read with pleasure almost every word of psychologist L. Edward Deci, whom Kohn so reveres. Intrinsic motivation and autonomy have been major, if not dominant, themes in all three of my books. And I acknowledge that the astonishing success of enterprises such as NUMMI are testimony to the importance of intrinsic motivation and self-control. For drawing attention to those issues, Alfie Kohn deserves two full and hearty cheers.

But I must withhold cheer number three, for I feel that, overall, Kohn is addressing matters of secondary concern. Excessive emphasis on incentives and competition is simply not a widespread problem in American business. What we need is a lot *more* positive reinforcement, and a lot less of the negative kind, throughout the corporate landscape. And far from cautioning companies about the dangers of incentives, we should be applauding those that offer their employees a bigger piece of the action. Likewise, we should welcome competition, whatever its source. We have competitive pressure to thank for the positive things that are happening in large companies these days, including the new willingness to copy from the best. Better than the practices of inward-looking companies and workers, closed to ideas that were Not Invented Here. They are the ones who have made such a bungle of American economic performance worldwide over the past 20 years.

Life ain't simple, as that *New Yorker* cartoon suggested, and neither is business. Kohn has much to say that is thoughtful and wise, and that ought to be heeded. But let's not ignore the forest for the trees. □

Tom Peters's most recent book is *Thriving on Chaos*.

**We have far
more to fear from
too little
competition than
from too much.**

The Author Replies

—and refuses to back down

BY ALFIE KOHN

When Tom Peters argues that the problem in the real world is too little positive reinforcement rather than too much, he is doing two things at once. He is describing what's going on, and he is prescribing what needs to be done instead. I have no quarrel with the first. But the cartoon phrase "Oh, if only it were so simple . . ." seems more appropriate to Peters's prescription—that we should just crank up the positive reinforcement—than to my review of the hidden problems with this tactic.

I do not dispute his argument that praise is better than punishment. Likewise, I say "amen" to his call for more goodies to find their way to workers instead of executives. The research shows quite clearly, however, that—when people feel controlled by praise, or when they come to think of themselves as working for extrinsic rewards—quality is likely to suffer. Peters's suggestion that we simply base those rewards on quality rather than quantity will not solve the problem. It may well be true that we have the capability to "keep score on quality," but it is clearly untrue that "the sheer act of keeping score will provide a positive stimulant to improvement."

The problem is not just that an artificial incentive for doing a job well is a less effective motivator than intrinsic interest in the job. It's that the incentive can actually do substantial damage by eroding that interest. And the more a task involves creativity, the more a manager must take care in handing out bonuses and praise. All else being equal, concentrating on the score is probably

an *obstacle* to improved performance in the long run, at least for tasks more complicated than licking envelopes.

Up to this point in the discussion, though, my differences with Peters are probably more a matter of emphasis than of substance. I agree that workers ought to be recognized more for their efforts, and he agrees that rewards can stifle innovation. But we part company, and I think Peters parts company with the data as well, on the question of competition. As I tried to show in an earlier column ("No Contest," November 1987), the best amount of competition in a company—or anywhere else, for that matter—is none at all.

Even though it's well supported by the evidence, this fact flies in the face of everything we were raised to believe. It's hard to accept the painful truth that we are all made losers by the race to win, that excellence has nothing to do with beating others, that any win/lose arrangement not only is psychologically destructive and ruinous to relationships, but also inherently counterproductive.

A close reading of Peters's examples shows that the wonderful results he cites were not really a result of competition at all. Is social comparison or learning by observing useful? In moderation, yes. But benefiting from others' example isn't at all the same thing as trying to defeat them. Does the Toyota-General Motors collaboration seem to be successful? If so, it's because of the employee involvement Peters describes. I'd be willing to bet that the workers (and their productivity) are thriving in *spite* of the additional element of group competition, not because of it.

It baffles me that someone with Tom Peters's expertise would help perpetuate the myth that "we have far more to fear from too little than from too much competition." What we have to fear is too little attention to quality, and competition is to quality as sugar is to teeth. Its effect on self-esteem is similar.

The research to back this up (which I review in my book, *No Contest: The Case Against Competition*) is so persuasive that I'd say the single most damaging mistake a company can make in devising an incentive plan is to set it up competitively. If a bonus is to be made available to employees, any individual (or, better yet, any team) that reaches a certain level of performance should receive that bonus. A contest sets us against one another, so that my success makes yours less likely. In reality, we have a great deal to fear from too much competition, and any amount is too much. □

SECTION VII: ACCOUNTING IN THE NEW ECONOMIC AGE

Face-to-Face: Accounting critic Robert Kaplan (Interview). (April 1988). Inc., pp. 55, 56, 58-60, 63, 64, 67.

In this interview, Harvard Business Professor Robert Kaplan, co-author of Relevance lost: The rise and fall of management accounting (Harper & Row, 1987), criticizes several aspects of the accounting systems currently used by managements of U.S. corporations. He asserts that the practice of using financial information to make strategic decisions is fatally flawed. Specifically, current cost accounting practices distort production costs, managers misinterpret reports, and the financial accounting system favors certain types of management decisions, such as growth over profitability, and low investment in research and development. In addition, he advocates changes in the types of data used by management for decision making. For example, accountants more familiar with the types of data needed for decision making in manufacturing or other functional areas of the organization might develop new accounting practices that more accurately reflect costs.

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Accounting Critic ROBERT KAPLAN

Because of the conventions of accounting, most companies don't really know what their products cost or how to go about trimming expenses

At business schools around the country, an entire generation of American managers has been trained to run companies by the numbers. The result has been an unmitigated disaster for American industry. Robert S. Kaplan has an explanation: it's because the numbers themselves may be wrong.

The numbers, of course, are contained in the financial reports of every company, which calculate down to the penny profits and losses, revenues and expenses, assets and liabilities. Managers have been fooling outsiders with these reports for as long as they have been compiled. What is worse, say Kaplan and his collaborator, H. Thomas Johnson, is that they may have been unwittingly fooling themselves about such important things as the true costs of products and the best way of controlling expenses.

Now come Kaplan and Johnson with *Relevance Lost*, a slender volume that has begun to cause something of a stir in the usually smug and complacent offices of chief financial officers—all the more so because the book suggests that CFOs set up their own, simplified management accounting systems to help them make crucial management decisions. Anyone who has railed against the bean-counters in his own business will certainly take some pleasure in watching as the accounting profession is taken to task for its preference for precision over accuracy and consistency over relevance.

Senior editor Steven Pearlstein spoke with Kaplan at his office at Harvard Business School.

INC.: It is a rare chief executive officer who hasn't found himself exasperated by his accountants and their rules. Is it fair to say that you come with confirmation that the bean-counters of this world are indeed off the mark?

KAPLAN: Yes and no. You have to understand that there are really two types of accounting. There is financial accounting, which is what companies do for shareholders, creditors, tax authorities, and the like, prepared according to rules that have been established over the decades. Now you or I might have some quibbles with those rules, but that is a separable issue. More important now is that managers are adapting those financial statements and using them to make important decisions about their companies. And for that purpose the statements are fatally flawed. They cannot tell managers what it is costing to produce various products, or how to evaluate correctly the performance of particular units or managers, or which lines of business are more or less profitable, or even where the company should be cutting its expenses. And *that* is a major problem.

INC.: So your gripe is not with accountants and CFOs, or with the SEC, or even with the IRS.

KAPLAN: Right. What I'm talking about is a management failure—a failure to recognize how important good information is to manage and run a business.

INC.: You mean information at such a basic level as what it costs to produce a product.

KAPLAN: That's right. Let's take the example of a factory. When most managers think of what it costs to produce a product, they think of three things: labor, materials, and overhead. Over the years, they've become very adept and very precise at measuring labor and materials. But they've never been able to get a handle on that big blob out there called overhead.

INC.: Which we typically think of as heat, lights, building, maintenance, that sort of thing.

KAPLAN: And that's the point, because it is so much more than heat and lights and buildings. Overhead, it turns out, is as much involved in information processing, in keeping track of parts, in ordering inventory, in keeping engineering drawings up to date. Overhead is generated every time you need to start a production run, or change a machine over from one part to another, or move material from one machine to another, or retrieve items out of inventory, or perform routine shipping and receiving operations.

INC.: And what is the relationship numerically between direct costs of labor and materials and all these indirect costs?

KAPLAN: In most manufacturing plants, it would be normal for overhead costs to be five or six times the direct labor costs.

INC.: And this doesn't even include things like sales and marketing expenses.

KAPLAN: No, those are so-called below-the-line expenses—selling, general, and

administrative expenses. Typically those run 20% to 25% of total costs.

INC.: So overhead, whether it is above the line or below, is a big number.

KAPLAN: Enormous—and there's where you have the problem. For the way those costs get assigned to various products in most companies turns out to be rather whimsical and arbitrary. In the case of factory overhead, for instance, the criterion most often used is direct labor cost.

INC.: Which means?

KAPLAN: Which means that if a company uses 10% of its labor time in making a particular product, then 10% of the total overhead expenses are assigned to that product as well, whether that product uses overhead resources or not. That is the way inventory has always been valued under the rules of financial accounting. So, the reasoning goes, why not use the same principles for the purposes of management accounting?

INC.: And the problem with that is that you may be assigning 85% of your production costs, the overhead, on the basis of 15%—the labor.

KAPLAN: And that introduces opportunities for enormous distortions.

INC.: Give a real-life example of that kind of distortion.

KAPLAN: Let's suppose we manufacture semiconductors, and we start out making what look like very garden-variety memory chips. Maybe it involves 10 operators working with 10 machines making 16K chips in a clean room. Since every chip is the same and uses roughly the same amount of labor, figuring out how to assign the cost of the clean room to every chip—the overhead—is just simple arithmetic.

Now, the product engineers come along and develop 64K chips. That product is a little more complicated, and so we use a more automated, expensive machine to produce it. It has less labor content. We decide to replace five of the old units with a few of the 64K chip machines in the clean room, and recalculate the cost of the clean room and reassign overhead costs on the basis of labor hours used to produce each chip. Guess what? The cost of the 16K chips just went up.

Then, we get into 256K chips, which require a very expensive machine that is almost fully automated. We drop one of those into the clean room, and now we

discover that we aren't competitive at all in 16K chips. Why? Because our costs are too high.

INC.: Which is really only a fiction of the accounting system.

KAPLAN: Exactly. As we added the new technology, the costs have systematically been shifted onto the product that has the highest percentage of labor content. And, boom, all of a sudden we decide to contract out the production of 16K chips to a plant in Singapore.

INC.: So you've "reduced" the cost of your 16K chips, but only by shifting costs back onto the high-end products.

KAPLAN: You see where this is all leading? First of all, most of the costs of the clean room are still there and have to be assigned somewhere. And, in addition, you now have the added costs of identifying and managing a relationship with your new Asian supplier. In most companies these become general and administrative costs that tend to be spread among all products, or—even worse—attached only to the products manufactured in-house because they are the ones with the direct labor.

INC.: So the costs for all the other products produced in-house suddenly go up, and the company wants to outsource even more aggressively.

KAPLAN: You've got it. And that's called the hollowing of the American factory.

INC.: Are you suggesting that the common assumption that, in America, we can no longer produce simple, commodity-type products at a competitive price might be based on a misperception driven by a faulty cost-accounting system?

KAPLAN: Not completely, but somewhat. Remember, the way to build an inexpensive, low-end product is the way Henry Ford built the Model T. It's a simple, plain vanilla product with no features, no options, so you have a very simple production process. It is only when you add in options that you create what I call "the hidden factory"—all those overhead costs associated with managing all that diversity. Somebody wants it in gold, somebody wants it with this dial or with that extra capability. Providing those options turns out to be very, very expensive. But those expenses have never been made obvious through the cost system—they are simply aggregated and assigned evenly to all products, including those that don't have many options.

INC.: So if we had more vanilla-product

factories, maybe we could still be making money with vanilla products.

KAPLAN: That's my guess. And even if our profits on these low-end products were a little lower than we usually expect, it might be worth it. Remember, once a foreign competitor comes in at the low end, it is able to set up an extensive distribution system and establish some credibility in the customers' eyes. Then it moves upscale, and it starts going after the other products—those that the financial accounting systems tell us are really profitable.

INC.: Most of the misallocation of costs that we've been talking about has to do with production costs. Do you find the same problems below the line, with selling and administrative expenses?

KAPLAN: All the time. Different products, different customers make very different demands on those below-the-line expenses. If I'm a food processor in New Jersey shipping to a grocery store in Alaska, I've got a huge expense there. But it doesn't show up on that piece of business because the expense of dealing with the Alaskan customer and shipping him product goes below the line and gets applied to all products equally.

INC.: The notion that some costs are fixed, while others are variable, is a common way for managers to look at things. Is there a problem in doing that?

KAPLAN: There is. Most people tend to think of overhead as a fixed cost—an expense that would remain the same whether you were producing a million widgets a day or half a million. But the so-called fixed overhead charges aren't really fixed at all. Oh, sure, they are fixed with respect to changes in output in any given week or month. But there is nothing pre-ordained about them.

INC.: So how did they get there?

KAPLAN: Somebody comes into the vanilla factory and says, "I have a customer who is interested in buying some butter-pecan swirl. I think we could make some money with it because it would sell at a premium. And anyway, the Japanese don't make butter-pecan swirl." So you look at the incremental costs of adding this new product and it looks fine. Most of your costs are fixed anyway, and the variable costs of adding the new product are minimal. So you add butter-pecan swirl. Then somebody suggests pistachio. And cherry vanilla. And each time it looks like a winner. The result is that, over time, you keep bringing in products based on their apparent incremental costs and

ROBERT KAPLAN

incremental profit, when in fact the changes are more than incremental. You need people to do the changeover from one product to another. You lose output during the change. You need more inspections to make sure that the pistachio is just right. You have a more complicated inventory system, more complicated bookkeeping, and so on. And all of a sudden, overhead starts to grow. And what you realize is that overhead is not really fixed—it varies. But it doesn't vary the way we have traditionally thought about variation, that is, with the amount of output. It varies with decisions about the complexity and diversity of product line and channels of distribution.

INC.: Are there any costs you think are truly fixed?

KAPLAN: I'd say that, for most purposes, all costs should be considered variable.

INC.: And when people say they want to embark on a new venture of some sort to help absorb overhead...

KAPLAN: ... Then you know they are

making the decision for the wrong reason. The only reason to launch a new product is because you expect the revenue to exceed the cost of designing, building, and delivering the product—not because it absorbs overhead.

INC.: But surely there is logic in looking for ways to put some use to underutilized capacity.

KAPLAN: If you have a profitable product to produce, sure. But there may be just as much logic in downsizing the capacity, and that is often the better course. We find, in fact, that in many companies, somewhere between 15% and 20% of the activity generates between 80% and 90% of the revenue.

INC.: So what does that tell you?

KAPLAN: It tells you that somebody is working awfully hard to get those last 80% of the products out. And maybe the wiser course is to drop your capacity a little bit, trim that overhead, pare back that infrastructure, and stop offering some of those products. Again, the problem is that companies too often think of that overhead or that infrastructure as being fixed, so the only choice they have if they want

to improve profitability is to come up with new products in order to use that last amount of capacity and generate all that wonderful "incremental" revenue. What they don't realize—and what their financial accounting systems won't let them realize—is that the sum total of all those incremental decisions is to generate a whole lot of hidden overhead.

INC.: So rather than increase profitability, what you are saying is that these incremental activities may actually lower it.

KAPLAN: I'll give you an illustration. A couple of months ago, I went through a food-processing plant in New Jersey. It was producing 125 different products. During the tour, I got into a conversation with the plant superintendent and found out that 15% of the products generated 85% of the sales. So I said, "Let's suppose we cut away 85% of the products that are generating only 15% of the sales. What difference would it make?" He started thinking and he said, "My goodness. We could start to move our production processes much closer together. We could close two floors and board them up." In his mind, he was already redesigning the factory for simplicity. He probably would have lost a little in sales, but the

plant would have been much more profitable.

INC.: Is it fair to say there is an anti-growth bias behind your accounting theory?

KAPLAN: Look, everyone likes to be associated with a growing business. They are much easier to manage. They create the illusion, if not the reality, of success for the people who run them. When we come along and ask people to look at their costs in a different way, it forces managers to challenge some of their basic assumptions, which can be pretty threatening. A few years ago, one company rejected our proposal for trimming back the operation to reduce complexity and improve medium- and long-term profitability. The division managers said, "No, no, you can't cherry-pick the line. You just can't look at it narrowly." It went against the ingrained culture of the company, which was to strive for increased sales.

INC.: And have sales continued to increase, as far as you know?

KAPLAN: It's interesting—that particular division was sold a year or two later to some other company.

INC.: And what about the argument that you need to have a full line of products, or be a full-service provider, in order to be competitive—that you can't sell vanilla unless you also offer pistachio and butter-pecan swirl?

KAPLAN: Obviously, that is a marketing calculation, not an accounting one, but I'd say that it's less true today than most people think. Remember that when foreign suppliers come in from overseas, they don't usually start out as full-line producers. They look at where the bulk of the sales are, and they try to satisfy that. And by being focused, and having much simpler operations, they can often offer considerable discounts off the existing price for high-volume products. What happens is that customers will buy the vanilla product from the overseas supplier, and go to the domestic supplier for all the fancy kinds of low-volume, customized products. That puts the domestic producer in a terrible bind, because now he is stuck offering all the complexity, and generating all that overhead expense, without the cash flow coming in from the high-volume products.

INC.: OK, but let's go back to that crucial point when you are thinking of starting up

a new product line, or having your company offer a new service. You don't know whether it is going to be successful, but you do know that, in a cost-accounting sense, if you burden this activity with its full and fair share of overhead right from the start, it will always look like a loser. It will never really have the chance to develop the kind of volume that could sustain that overhead burden. I imagine such a cost-accounting system could get pretty stifling for a business.

KAPLAN: I don't think that's a problem with the accounting system. It is a problem with how people react to the information that it generates. One way to react to the situation you describe is to say that the product is just not profitable, or not profitable enough, so we won't do it. But another way is to say, "I know that, at least during this start-up period, we are not going to have enough volume to cover the infrastructure we need to launch this product. But we are going to calculate what those losses are and treat them as investments—investments just like physical investments we might make for a new plant or new machinery."

In other words, in order to justify a new venture, you can either play games with the accounting system, keep costs

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away from it, and try to kid yourself. Or you can say, "We are going to lose money on this initially, but let's understand exactly how much, so there is no question what the real breakeven point is and, if it is successful, the rate of return."

INC.: And, presumably, you would design

your management accounting system to keep track of new ventures in that way.

KAPLAN: On a project-by-project basis, that's right. Which, by the way, is very different from the way financial accountants go about it. For their purposes, expenditures that are made for future products and processes are all aggregated and written off immediately as expenses of the period. Now from their perspective

that makes sense. If they were to treat them as bona fide investments, then they would have to carry them over to the balance sheets as assets. And if auditors came into the company to try to find the asset, they couldn't find it. It is nothing that they could confirm in any way. They can't assign any value to it. So they take a conservative view and write it off.

INC.: What other expenses would you put in the same category as R&D in your idealized management accounting system?

KAPLAN: Maintenance. Employee training.

INC.: OK, but how would you handle these on your management accounting books?

KAPLAN: I might put them into an account called intangible investments.

INC.: And would you spread those expenses over five years? Ten? Would you try to assign them to particular products?

KAPLAN: I don't think you want to be too precise on this. I would not worry too much about whether I was amortizing those costs over 5 or 10 years. Remember that the purpose here is simply to avoid giving management an incentive, when times get tough, to cut back on some of these "discretionary" expenditures in order to achieve their budget or meet some sort of performance goal. In evaluating managers, a company should distinguish those who make their budgets by sales increases and reductions in the cost of producing goods and services from those who make it by cutting back on investments in the future. The financial accounting system doesn't allow you to make those distinctions very easily.

INC.: We've talked about a couple of ways in which the financial accounting system tilts toward certain kinds of management decisions—toward growth over profitability, toward scrimping on training and R&D. Any other big areas?

KAPLAN: The question of debt financing versus equity is another one.

INC.: How is that affected?

KAPLAN: When you have debt financing and have to write out a check to creditors every month, it is very clear what the cost of that capital is. The interest expense shows up on the financial statements, and you can take that expense and bring it right down to divisions or even products. On the other hand, most companies don't send checks to equity investors, so if the business finances its

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growth with retained earnings, from the financial statements it looks as if that capital is supplied at no cost.

INC.: Are you saying that this cost of equity financing should be reflected in the financial accounting, the management accounting, or both?

KAPLAN: I think both. And you can see what happens today when you don't make this cost of equity capital explicit—it makes companies vulnerable to such tactics as takeovers and leveraged buyouts.

INC.: Why?

KAPLAN: Because companies treat retained earnings as if it were essentially free capital, they are given an added incentive to grow—to diversify into new areas, to open up new product lines, to buy up other companies, and so forth. And in many cases, those investments are not earning a competitive rate of return. Now along comes a generation of investors and raiders who say, "We don't want managers to keep investing in these low-return projects. We think that if there is extra cash around, they should pay that cash out to the shareholders. And in fact, we are so sure of this analysis that we're going to pay a premium for the company and try to take it over, and pay for it with debt—even with high-interest debt called junk bonds.

INC.: And it's not surprising that when they get into those companies, those subsidiaries that aren't providing an adequate return on capital are usually sold off.

KAPLAN: That's right. In fact, when you go back and talk to managers who have taken their companies private in a leveraged buyout—and now they have to write that check every month for their capital—they have a very different attitude toward diversification. The cost of capital to them has been made much more explicit—although it was always there. And that is certainly one reason that they tend to run their companies more efficiently, with less slack in the system.

INC.: What about service industries? Do people there even worry much about cost accounting?

KAPLAN: For a long time they didn't—at least not in the sense that we talk about it in manufacturing, of trying to assign costs to particular products. Service businesses collected costs by functional centers or departments, and these were compared with the budgets for those departments.

And that was about the extent of it. There was no real sense of product costs.

INC.: Nor any clearly defined sense of product, I imagine.

KAPLAN: But that is changing. In some key service industries—financial services, transportation, telecommunications, and health care—businesses that were once under some sort of price regulation and

also protected from much competition are now scrambling to understand all about product costs, because there is increased competition that makes it impossible to have certain products subsidize others and get away with it. These companies now have to make money on all their products. And that requires knowing exactly what each product is and what it costs to provide all of them. In fact, in this environment, there is a more

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compelling need for service companies to think hard about product costs than even manufacturing companies.

INC.: I can imagine most of our readers getting this far and thinking, "Oh, this is wonderful. Kaplan wants every company to have every employee keeping time sheets down to the minute on which accounts or which products he's working on. Every phone call, every photocopy, every expense-account drink has to be assigned somewhere. It would be a nightmare."

KAPLAN: I wonder if they would not be falling into a common pitfall here, which gets back to what I said earlier about the difference between management and financial accounting. The financial accountants, if they were given this assignment by nature would be inclined to try to nail all these hidden costs we've talked about down to five significant digits. And your readers would be right—to do that would be a nightmare. But what the management accountant says is, "We don't want to know five significant digits. What we want to know is if some of these overhead expenses are smaller than a bread box or bigger than a bus? Are you spending 10% of your time on an activity, or 70%?" If we can just get an order of magnitude like that—if we can just get the first digit right—that would be fantastic. And it would be so much more accurate than what we have now, even though it would be less precise.

INC.: And you don't see even getting that first digit right as a huge task?

KAPLAN: No, I don't. You can get it simply by talking to people. Go to the shipping department and ask them, "What takes up most of your day? What's difficult and complicated? What's easy?" They know where they have to add on extra people, when things are slack. And after you talk with them a while, you say, "It sounds to me as if you spent twice as much time on this product line as this one, or this customer as that one. Is that about right?" And they say, "Well, maybe not twice, but 50% more." And that's fine, because even such rough allocations begin to ask such crucial questions as, why are there 13 people in the receiving department? Granted, I may not want to put out audited financial statements based on these judgments, but for internal purposes, I would be getting much better guidelines for where problems might lie or new opportunities might be.

INC.: And how detailed do I want to get

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KAPLAN: The aim, of course, is to try to get a true picture of how overall expenses break down—by product line, by geographical region, by marketing channels, even by customer. But remember, you're striving for accuracy, not precision. You stop the process when you are uncomfortable—when you find that you are making allocations or attributions that are arbitrary, where there is no real notion of causality, or where the amount involved is insignificant.

INC.: Do you keep track of these things on a daily basis?

KAPLAN: No, not at all. For a business that doesn't change very much, that doesn't have any major introductions of new products, just an annual calculation would be sufficient to make pricing decisions, to understand product profitability.

INC.: And do you put the CFO in charge of it?

KAPLAN: Ideally, you get someone who knows the operation from the ground up and who can make sure the numbers make sense. And that usually means you have to separate the management accounting function from the financial accounting.

INC.: Is that preferable to trying to reform a company's financial accounting system and practices so that they can generate better reports for managers?

KAPLAN: Most CEOs, and most general managers, don't feel that the accounting system will ever be really under their control. There is a certain mystique about the conventions of financial accounting—FIFO, LIFO, flow through, deferred. Non-financial managers don't want to get into all these boring details. So they've delegated that responsibility to a set of people who, over time, have become removed from operations. These people have not been close to the process of designing, building, and selling products. They have installed complex systems to ensure that the numbers add up, that the numbers have integrity, that the company gets a clean audit opinion at the end of the period. Now, an executive comes in and says, to the accountants, "These numbers are late, they're too aggregated, and they're not helpful in making decisions about what products to produce and where to cut costs. Change it." But by that time, it is hopeless. Better to start out fresh with a separate and much simpler management accounting system. □

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SECTION VIII: QUALITY IMPROVEMENT IN SERVICE AND MANUFACTURING: CASE STUDIES

Scholtes, P. R., Weiss, L. S., & Reynard, S. (1988). Quality improvement in the office. Available from Joiner Associates, Inc., P.O. Box 5445, 3800 Regent St., Madison, WI 53705-0445.

Baker, E. M. (Winter 1989). The evolution to total quality excellence. Dialogue, pp. 7-13. Available from E. M. Baker, Director, Quality Planning and Statistical Methods, Ford Motor Company, Detroit MI 48121.

Artinian, H. L., & Baker, E. M. (1988). Improving quality: The critical hidden link. Paper presented at the 1988 ASQC Quality Congress Transactions, Dallas, TX.

Orsini, J. N. (May 1985). The quality-productivity connection. United States Banker, 96(5), 86-87.

McDaniel, D. M., & Doherty, L. M. (February 1990). Total Quality Management case study in a Navy headquarters organization (Tech. Note 90-10). San Diego: Navy Personnel Research and Development Center.

This set of articles describes organizational improvement efforts in service and administrative areas. The philosophy and methods for improvement described in previous sections of this volume are employed in these improvement efforts.

Scholtes, P. R., Weiss, L. S., & Reynard, S. (1988). Quality improvement in the office. Available from Joiner Associates, Inc., P.O. Box 5445, 3800 Regent St., Madison, WI 53705-0445.

This article applies the scientific method for improvement of processes described in the previous section to an administrative situation, with suggestions on how to avoid common pitfalls in such improvement efforts. Steps in the improvement cycle are explained and illustrated. The authors also provide guidelines for management involvement and for the use of project teams.

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Quality Improvement in the Office

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Peter R. Scholtes is a senior consultant with Joiner Associates Inc., and one of the few leading proponents of continuous improvement whose professional background is in Organization Development. He has over 20 years of experience in planning and implementing change in a wide range of organizations. This experience, coupled with in-depth knowledge of quality management practices gives him a unique perspective on what it takes to build a world-class quality organization: a transformation of the relationships, environment, and the dynamics within and between individuals and groups throughout an organization. Only then can quality become a natural part of how business is conducted. Mr. Scholtes helps organizations become aware of these dynamics and integrate that awareness into strategies for achieving continuous quality improvement.

Mr. Scholtes works primarily with top management to plan, coordinate, and oversee application of quality management principles in their organizations. The cornerstones of his work are training and consultation devoted to educating managers on the theory, skills, methods, and tools needed to guide the efforts of their employees. He also helps companies develop the capability to build effective project teams whose members are well-versed in the planning, statistical, meeting, and organization skills needed to accomplish their tasks.

Two of Mr. Scholtes' recent papers have drawn national attention: "Beginning the Transformation" (see *Quality Progress*, July and August, 1988) and "An Elaboration on Dr. Deming's Teachings on Performance Appraisal." He is also the principal author of *The Team Handbook: How to Use Teams to Improve Quality*, which sold well over 30,000 copies in its first year. Mr. Scholtes is frequently invited to speak at major national and international conferences, including the 1st and 2nd William G. Hunter Conference on Quality, and the British Deming Association's annual conference. He holds a Master's degree in Education from Boston University, where he studied with Malcolm Knowles, and also completed additional studies in the fields of management science, philosophy, and psychology.

Lonnie S. Weiss is a consultant with Joiner Associates Inc. with over 12 years of experience as a consultant, trainer, and group facilitator specializing in organization development. She works with managers to help them develop and practice quality leadership skills; designs and delivers training programs in quality tools and concepts to managers and supervisors; and designs and delivers training programs and consulting strategies for team building, conflict mediation, and meeting facilitation.

While at Joiner Associates, Ms. Weiss has consulted with companies in the automotive, food, computer software, paper, and oil industries as well as with health care providers and utility companies. Her prior work experience includes four years of operating her own consulting firm, Constructive Communications, during which she worked primarily with government and service organizations.

Ms. Weiss has designed several core Joiner seminars and workshops, including "Quality Improvement in the Office," a one-day seminar Joiner began offering in April 1989. A paper summarizing this workshop was an invited presentation at the Annual Quality Congress in Toronto (May, 1989). Her publications include *Conflict Resolution Skills*, *A Trainer's Manual* and *Building United Judgment*, *A Handbook for Consensus Decision Making* (which she co-wrote). She was also a contributor to *The Team Handbook: How to Use Teams to Improve Quality*. Ms. Weiss has a Master's in Organization Communication from the University of Wisconsin-Madison, and a bachelor's degree in Psychology from Cornell University. She has also pursued advanced studies in adult education and change strategies.

Sue Reynard is a writer and editor with Joiner Associates who greatly enjoys helping people like Peter and Lonnie get their work into print. It was a pleasure, as always!

Quality Improvement in the Office

**Peter R. Scholtes
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Abstract

Despite a growing body of literature on quality improvement, people working on administrative or office processes still have a hard time finding examples that pertain to their situations. This paper addresses the special problems encountered in administrative processes, with specific suggestions on steps to avoid common pitfalls. Using project teams to tackle large or complex issues is a particularly effective way to draw on the creativity of many people and involve operators and managers in the changes that will affect how they do their work. To be successful, projects must be tied closely to the key issues of the organization and its management.

This is not to say that making changes in manufacturing settings is easy. All change is difficult. Yet the problems of change seem amplified when used in a setting where feelings and politics are often the biggest determinants of when and how work gets done. Still, the principles of quality improvement do apply in the office, and our knowledge about how to make it work there continues to grow.

This paper presents two aspects of the issue:

1. First, we discuss a basic plan for improving administrative processes, and how this plan applies to fuzzier managerial initiatives such as changes of policy.
2. Then we talk about how this plan can be implemented using one of the most effective quality improvement tools—project teams—including some practical advice on launching an administrative project.

1. Introduction

The hunger for information on quality improvement continues to grow rapidly in this country. As many people have found out, however, those interested in manufacturing applications have an easier time finding what they want on the menu. Thus far, more work has been done about improving quality on the factory floor than in the office. This bias away from administrative problems is understandable: problems are easier to identify and track when standards have been set, processes easier to describe when they rely on well-defined procedures and physical constraints such as machinery settings or the laws of chemistry, and changes easier to swallow when they involve gadgets.

Since most of the literature on process improvement is about manufacturing, we hope managers and administrators will find it easier to learn from the cases and examples presented here than from those originating on the factory floor.

II. A Basic Plan for Improving Administrative Processes

A. Background

Are improvement methods any different for administrative than for manufacturing processes? The answer—when all is said and done—is that the improvement methods and tools are basically the same. Then why the separation? The most important reason is that differences between the manufacturing and administrative worlds affect how methods and tools are used in the workplace. For instance:

- Technology is usually more sophisticated in manufacturing (with the exception of some complex computer applications).
- Politics are usually more delicate in administrative areas.
- Manufacturing processes are ordinarily better defined: the boundaries and specifications of the process are known; key quality characteristics of the product are defined; management/ownership of the process is more obvious; the critical control points have been identified; and corrective measures are part of every operator's training. An administrative project may not involve a single process, and if it does, most of the above characteristics are likely to be ambiguous at best.¹
- Measurement systems are used regularly to judge the performance of manufacturing processes, and to guide operators' actions. Measurements are seldom taken or used on administrative processes.
- Manufacturing processes inherently have a greater volume of products than the majority of administrative processes. As a result, (1) there is a larger pool for collecting and analyzing data, and (2) adjustments to a manufacturing process are likely to show their impact right away. Feed-

back is immediate. Even in repetitive administrative processes, the effect of a change may take weeks or months to surface, thereby lengthening the data collection portion of a project. For example, if telephone operators changed how they answer the phones, it may take months before data would reflect whether customer satisfaction was increased or decreased.

There are other differences that affect how quality improvement is carried out in administrative settings. By and large, people engaged in administrative processes have a different learning curve when it comes to understanding and applying statistical approaches. They are less used to technical analyses—not incapable of it, just unfamiliar with the approach. Therefore, in teaching process improvement, it makes sense to adjust to the readiness and comfort levels of the non-manufacturing learner. The basic improvement plan outlined below takes these differences into account, and stresses the "people" aspects of change.

B. The Basic Plan

The basic plan is a sequence of steps that reflect a logical, scientific approach to improving most administrative processes. People or teams inexperienced in using Total Quality improvement methods might use this plan as a recipe.² With experience, people will learn how to adapt and apply these approaches to different circumstances without compromising the integrity of the scientific approach. The plan is depicted in Figure 1 and described below.

Step 1: Define the Process and the Purpose of the Study

Key questions in this step are:

- What is the purpose of this study? What are the desired outcomes? Answers to these questions will help focus your work. If the leaders of the organizational unit don't agree to a purpose statement, the project is liable to float aimlessly like an airborne balloon until a gust of someone's hot air blows it onto a course of action.

Figure 1: A Basic Plan for Improving Repetitive Non-Manufacturing Processes

Step I	Step II	Step III	Step IV	Step V	Step VI	Step VII	Step VIII
Define the process under study and the purpose of the study	Catalogue the desired improvements	Describe the process using a flow chart	Identify the vital signs and monitor them	Regroup and design an improvement strategy	Localize recurring problems; identify the root causes	Design, discuss and test possible improvements	Standardize the improvements; monitor the results
What are the limits and operational definitions of this study?	Who are the customers, suppliers, operators, and proprietors of this process?	Use a deployment flowchart to illustrate how the process currently works.	Operationally define the key checkpoints or indicators of healthy process performance.	Develop a strategic approach based on process performance-indicator data and other pertinent information.	Where do they appear?	Develop an agreed-upon, best known available process.	Institutionalize the new process so that it is routinely followed by every operator, supplier, supervisor and proprietor.
Where does the process begin?	What are their needs, hassles, and concerns?	Involve the key players.	Gather data to profile the current capabilities of the process on these checkpoints.	Where should the improvement begin?	When?	Try it out.	
Where does it end?	What are the core interests and values of these stakeholders?	Look for complexity and inconsistencies.		How should the team be reconstituted?	Involving whom?	Monitor its effectiveness.	
What is included?					Where, how and why do they occur?	Get feedback from the customers.	
What is not?					What are the root causes?		
What is the desired outcome?					What are some contributing factors?		

- What process is involved? Where does it start and stop? Because work is accomplished through a series of tasks, it is not always easy to define where a specific process begins or ends. For example, does an order-entry process begin with the first inquiry, or when an order form is completed?
- Who are the operators, the people who work on the process daily?
- Who are the customers and suppliers? Be sure to look at both internal customers and suppliers (the people sitting next to you or in an office downstairs who give you information or materials or to whom you pass off your information or parts) and external customers and suppliers (the people and organizations outside your company who give you information or materials, or who use your product or services).
- Who are the process proprietors, the people who are ultimately responsible for its overall maintenance, functioning, and improvement?

Work to develop some basic operational definitions in the early stages of an improvement project. If you are investigating customer complaints, how will you distinguish them from other customer comments (suggestions, for example), or from complaints by non-customers. Veterans of improvement projects can tell horror stories of time wasted gathering data that proved unusable because definitions were fuzzy.

Step 2: Catalog the Desired Improvements

Having identified the key players, go out and listen to them: what are their needs, hassles and concerns? What are their deeply felt visions, values, and interests regarding this process, product, or service and their part in it? What are their musts, needs, wants, and delighted-to-haves? The project team will need to decide how to pursue this input from the key players. Some advice: while questionnaires may be useful, there is no substitute for small, face-to-face meetings with stakeholders (the people in your organization involved in or affected by this process) and with the users and purchasers of your service. If afterwards you need input from a larger population, you will have a solid base for creating a worthwhile questionnaire.

The in-house stakeholders can also provide invaluable background on the history of the process. How did it get to be this way? What trade-offs have influenced its development? However unworkable a system it may seem to be now, there are probably good reasons why it was done this way in the first place. Learning a little history may save the project team from mistakes or embarrassment, and help when you examine and describe the process. As you talk with process operators and other key players, be attuned to the conflicting pressures they face. What's most important, that the final product or service be on time? complete? accurate? attractively presented? How are these priorities communicated? Conflicting values and priorities result from inconstancy of purpose, and they can create numerous quality problems. Knowing what they are can help you identify the key quality characteristics of the product or service.

Step 3: Describe the Process Using a Flowchart

By now, you should know most of the elements of the process you're studying. In this step, you translate that knowledge into a form that will enhance further investigation: a flowchart. The value of creating a flowchart lies as much in the doing as in the resulting product, especially if your team convenes a flowcharting session and invites key players not on the team to join in.

Various types of charts may be useful. We recommend a deployment flowchart. this type of chart has columns headed by the names of key players, whether individuals or groups. The process steps proceed in time order down the chart, with each action box in the column corresponding to the key player who has responsibility for that step. A sample deployment flowchart is shown in Figure 2. The flowchart in its less-than-final version should be displayed prominently where others can see it and make comments. The project team then evaluates this feedback and changes the chart, if necessary.

- Review the described process for signs of complexity. Which of these steps would be unnecessary if the system worked flawlessly?

- What data do you have that shows signs of inconsistency between operators or shifts. Do any steps change with different operators? Try to reach consensus on the best-known method for doing this process.

Implement right away any obvious, workable changes you think will solve the problem if you are reasonably certain there will be no major negative side-effects should they prove to be wrong. Continue the more detailed project study.

Step 4: Identify the Vital Signs and Monitor Them

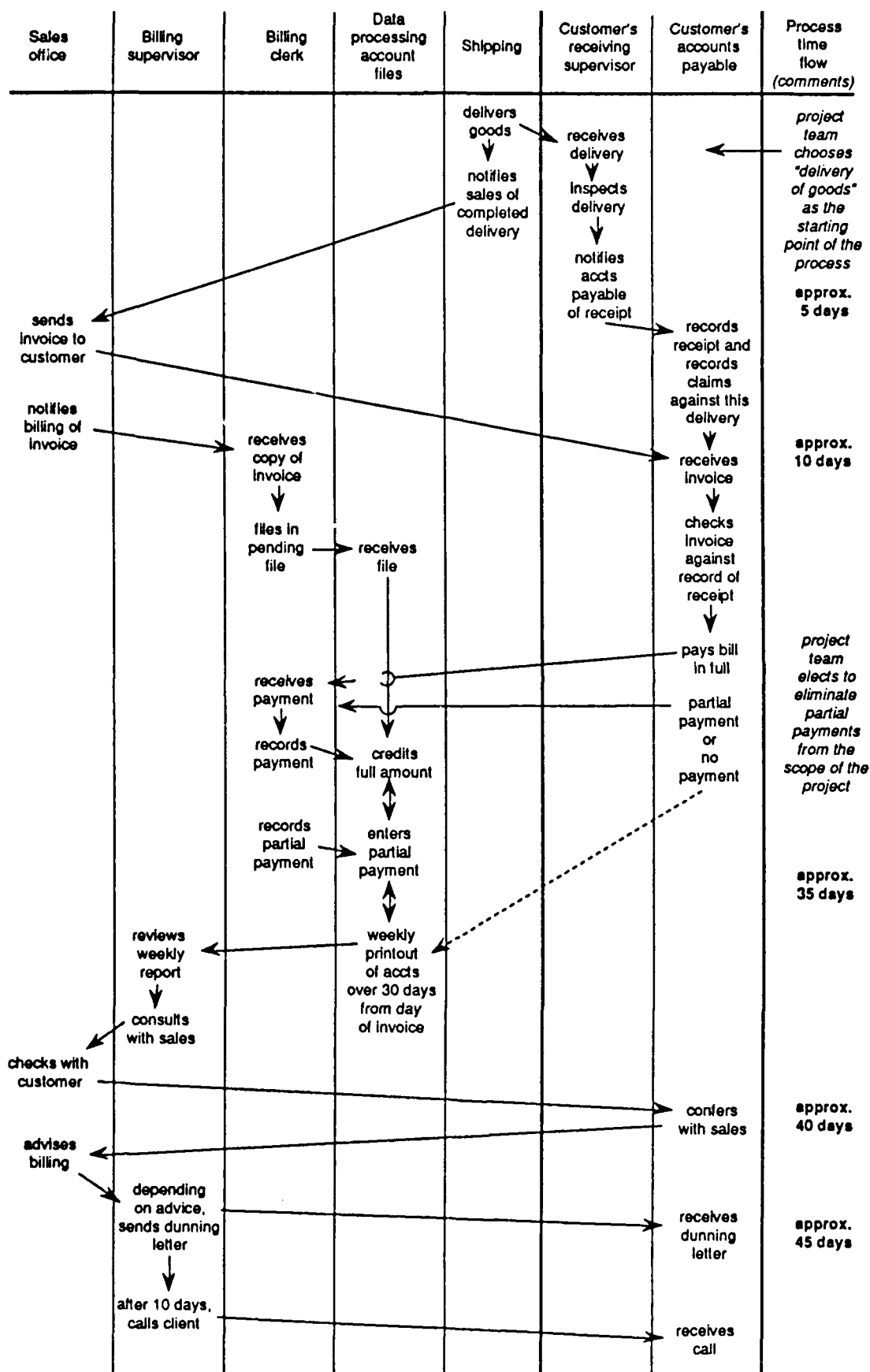
How can you tell how well this process is working? Operationally define any indicators you identify. Devise a workable measurement method for each key indicator—one that the people who will be taking measurements can understand and repeat with some accuracy. Establish an appropriate period of time for gathering data. The guidance of a statistician or someone else skilled in statistical methods can be extremely helpful. Here are some check points common to administrative processes:

- **Promptness:** How close to the promised date is the actual completion or delivery date?
- **Accuracy of estimates/forecasts:** How close to actual are the predictions?
- **Correctness:** Numbers of errors, inaccuracies; number of units with errors or inaccurate items; types and patterns of errors or inaccuracies.
- **Use of time/distribution of time:** Which steps in a process consume the most time? Which activities of employees consume their time? How much time is spent on complexity?

Some examples of key indicators:

- **Order processing:** number of orders being worked on in each step of the process; number and pattern of rush orders; number of revisions required; number of repeat customers not on file, reasons why they aren't on file.

Figure 2: A Deployment Flowchart of an invoicing process.



- **Accounts receivable:** number of late payments by length of delinquency; number and patterns of debit/credit memos; number and pattern of late payments due to claims.
- **Shipping:** accuracy of delivery forecasts; number of orders shipped within 24 hours; number of orders processed.
- **Inventory:** accuracy; timeliness of receipts; reasons for early or late receipts.
- **Personnel:** number and patterns of applicants for entry-level vacancies; turnover rates/patterns; pay rates, and especially differences in pay rates between previous incumbents and replacements.

Take data on these measures and develop run charts, control charts, dot plots, or Pareto charts that describe how the process is behaving. Drawing on the information gathered from interviews with stakeholders (Step 2), identify indicators that reflect: customer satisfaction and delight; operators' pride and hassle-free operation; suppliers' concerns and capabilities; proprietors' concerns and priorities. The team might also construct a cause-and-effect diagram to explore why certain events or patterns occur.

Step 5: Regroup and Design an Improvement Strategy

The data from Step 4, combined with the input from the stakeholders gathered in Step 2, should help focus your attention. This is a critical juncture for the project, a time to pinpoint exactly which major improvements to pursue, in which parts of the process, and involving which groups of employees.

At the beginning of a project, it is often unclear exactly where the team will be making changes. Team membership, therefore, is often set to cover many bases. By this stage, it may be clear that the team's composition needs to be adjusted to better reflect the issues that will be tackled. Do you have the proper people on the team? Are there areas of expertise that should be represented? Are there areas that are no longer needed? Be very careful here not to unnecessarily alienate

team members. Do not use this as an excuse to get people off the team. Decisions on team composition must be made by consensus.

Think about who else will be affected by the project—change is often a difficult process, and you'll increase the chances of success if your team informs the people expected to do the changing of what's going on. Ideally, consider opening your ranks to include some of these people so they can immerse themselves in the problem identification process and help design the changes that will be made.

Besides helping the team plan for its future needs, this regrouping encourages members to consider the possible controversies and sensitivities that frequently surround changes proposed in administrative areas. If no such controversies and sensitivities exist, this step may be successfully completed in one brief discussion, with no change in membership needed.

If the team composition does need to change, we recommend the following steps:

1. The project team presents a status report to operators, supervisors, and other interested parties. It identifies upcoming steps and the kind of assistance that will be needed.
2. The project team and its guidance team (described in section III B) discuss possible changes in their membership.
3. Guidance team and project team members invite new members to join, and brief new members on the work to be done.
4. New members are trained, old members depart. Take care to make it a graceful and celebratory transition.
5. The reconstituted project and guidance teams discuss likely resistance to data-gathering efforts or proposed changes. This information is incorporated into a plan to move ahead.

Step 6: Localize Recurring Problems, Identify Root Causes

When someone first notices a problem, it is seldom at the time and place where it originated. Discovering its cause often involves tracking down its point of origin. One useful approach, developed effectively by Kepner and Tregoe, is the is/is-not analysis, which is based on finding out where and when a problem does and does not appear.³ Another approach is to ask the question "why" five times. There is nothing magical about the number five here; the idea is just to persist until you have reached root causes.

Here's an example:

There aren't as many outstanding accounts as appear in our records.... **WHY?** ... Many overdue accounts are not late at all, but simply an error in our records. ... **WHY** are there errors? ... The records show missed payments when, in fact, the customers have paid on time. ... **WHY** don't the records reflect payment? Billing clerks have trouble properly crediting customers' accounts, especially on partial or composite payments. ... **WHY** do billing clerks have this trouble?... Because customers don't indicate invoice numbers with their payments. **WHY** don't customer include the invoice numbers? ... Customers are not asked to include the number, and the payment slips they return do not have spaces for putting invoice numbers on them.

After a pattern has been established, the project team can discuss what that pattern suggests about the location of the problem, or, perhaps, the cause of the problem itself. Creating a cause-and-effect diagram can help identify the possible causes of a problem. Proper data collection and analysis is essential at this stage to determine actual causes and locations of problems. If no one on the team is trained in these techniques, seek help from an experienced statistician.

Step 7: Design, Discuss, and Test Possible Improvements

Most of the time, the causes of administrative problems are easier to uncover than those in

manufacturing. Typically, administrative processes are less technically complex and the statistical challenges are correspondingly less demanding. Where administrative areas are characteristically more demanding is in implementing the change. It is easier to adjust a mechanical process than it is to persuade people to change their work habits, because manufacturing changes usually center around operating methods, machinery, and materials, and frequently have immediate, noticeable payoff. In administrative processes, solutions are less clear-cut, and the payoff for the correct solution is less immediately apparent.

These limitations are why Step 5 (Regroup and Design an Improvement Strategy) assumes such importance in administrative projects, and why this step so strongly influences the project's ultimate success. The goal here is to gain a critical mass of support for a new method of work:

- Education must be a major part. Let people see the data and the rationale behind recommended changes.
- Gain the agreement and support of influential people (no matter what their position in the company). Respond to their concerns. Invite them to be active in the undertaking.
- Persuade them to make a good faith effort to make the new method successful.

It takes careful planning, patient explaining, and many demonstrations and tests to gain understanding and support from those who, until now, have not been involved in the project. Forcing changes on people, keeping people uninformed, unpleasantly surprising people. . . these are ways to provoke resistance. The time spent helping people to understand and give input will be repaid with smoother implementation. Some guidelines to follow in this step:

1. Do a cause-and-effect diagram detailing what factors will contribute to successful implementation. Identify which people and processes affect which factors.
2. Make a clear, non-technical presentation, using plenty of understandable charts, to

the people affected by the team's recommended changes.

3. Consider introducing the innovation in increments: in a target area or for a trial period. This lets newcomers become comfortable with the changes before full-scale implementation, and lets you fine-tune ideas before all of your resources are committed.
4. Accommodate concerns and objections as much as possible without compromising the integrity of the proven solutions.
5. When training is necessary, carefully plan who will do the training, how it will be done, and who will train the trainers.
6. Early in the implementation, transfer the job of monitoring to the day-to-day operators. Determine what data will indicate whether the improvement is successful. How will this data be gathered?

Step 8: Standardize the Improvements, Monitor the Process

The project isn't over until the new best-known method is routinely used and supported by every supplier, operator, supervisor, and proprietor in the process.

- Signal the official, full-scale start of the newly redesigned process with appropriate hoopla.
- Incorporate the new process into operations manuals.
- If necessary, develop new job descriptions or classifications to represent new responsibilities.
- Prominently display instructions for the new process.
- Include the changes in new-employee orientation.
- Closely monitor the new methods at first.

C. Guidelines for Management Initiatives

Another category of improvements can be called management initiatives. These are the type that ordinarily arise from a leader's actions, and take on one or more of the following characteristics:

- The improvements challenge long-held practices, sacred cows, superstitions, or taboos—beliefs ingrained in the corporate culture.
- The manager starts with a solution, and there is good reason to go ahead without rigorous assessment of alternative solutions.
- The changes are aimed at an intangible need, such as morale, communication, or the organization's climate (changing a policy, for example).
- The initiatives introduce once-only or very rare change to a system (an office move, for example).
- There is no need to gather statistical data to verify that change is worthwhile.
- The change involves creating a new system to either fill a gap in present capabilities or replace an outmoded system ("better to build a new road than to pave the cow path").

When working on a problem that has any of these characteristics, work through the following guidelines:

1. Have a clear intention. Why are you doing this? Are you sure you aren't responding to a transient need? What are your assumptions? How can you tell you've picked the right problem to work on? Check your assumptions with other people involved with the system or process.
2. Be clear about key players. Who will feel ownership of the issue? Have you identified clearly the suppliers, customers, and operators? What are their needs? How will solving this problem help them?
3. Define the desired outcome. What do you want to have happen as a result of this

project? What magnitude of change or improvement is acceptable? How will you know when you've accomplished what you want to accomplish? Are there measurable indicators? Can you measure these indicators on the present process?

4. Follow previous guidelines for collecting data and analyzing the system. Collect data that will help you track down the root cause of the problem.
5. Engage the Plan-Do-Check-Act cycle. The PDCA cycle is gaining widespread acceptance as the best way to approach any change. It emphasizes that change must be preceded by a period of thoughtful planning and data-gathering (PLAN); that every change (DO) is accompanied by monitoring activities (CHECK); and that everyone involved in the process works to incorporate changes and use standard methods (ACT). The cycle continues as further improvements are identified, and plans are made to include them, etc. For more information, see Steps 7 and 8 of the Basic Plan, and The Team Handbook, Chapter 5.⁴

III. The Basics of Project Teams

A. Background

Having a plan for improvement is a big step towards ensuring success, but equally important is making sure the plan is carried out properly. For many organizations, quality-focused project teams are the way to go. Though only one element of a broader strategic plan—which should include organization-wide education and training, building a quality network inside the organization, and so forth—project teams are one of the most powerful forces for change. The benefits of project teams include tapping the creativity, knowledge, and experience of many people simultaneously, building a spirit of teamwork and cooperation among employees, and creating a workforce that is trained in quality improvement concepts and methods.

Today's project teams are similar to conventional teams in that both are convened to "problem-solve." But the similarity ends there, as shown in the chart below. In general, project teams rely more on structure and methods than conventional teams.

<u>Conventional Teams</u>	<u>Project Teams</u>
<ul style="list-style-type: none"> • 10 to 15 members • Members mostly technicians, engineers, or managers • Rely on the premise that putting the "best and brightest" people in a room together will result in the best possible solution • Data and the scientific approach are not used; operate by gut feeling 	<ul style="list-style-type: none"> • 5 to 7 members maximum • More often include line workers along with supervisors and managers to get input from people who work on the process daily • Recognize that having a METHOD is the crucial element; All people have the capacity to do an excellent job if given methods, tools, and guidance • Data and the scientific approach are pivotal to success

There are many sources that can help you run a project team.⁴ But there are six crucial elements that will help you get the most mileage out of any project, particularly in the highly politically charged environment of administrative and service operations.

B. Six Crucial Elements

Element 1: Linkage with Line Management and Key Business Concerns

Quality improvement projects should emerge from an overall organizational business plan and be linked to the organization's management structure. This means top and middle-level managers who have authority over the process to be studied must agree to support and coach the team. To get this agreement, the project inevitably has to be something that interests these managers because it supports and advances the organization's customer goals, business plans, decision structure, and internal communication systems. Typically, managers will work together as a guidance team to oversee the work of several projects simultaneously, and see to it that changes are introduced, improvements made, new methods systematized.

Element 2: Communication to Reinforce Links

Communication is essential to support and strengthen the project team's links with the rest of the organization. Teams must send copies of all meeting minutes to their guidance teams, and meet with them regularly even if there doesn't seem to be much to report. Since other individuals and departments are affected by and can learn from the work of project teams, communication must be directed organization-wide via display on bulletin boards, informational meetings, etc. A project team's work is not complete until they communicate their effort to the organization.

Element 3: Focus on Project and Meeting Management as well as the Improvement

A team's work gets done primarily through two avenues: meetings and project work. To do well, a team must consciously work to improve both. Key meeting management tools include agendas, ground rules, facilitation, active participation by all members. The team should keep detailed meeting minutes and project records, which serve as a group memory for team members and as documentation for new members who join the team later. The team should also evaluate both the process and content of each meeting, a use of the PDCA cycle described above that lets a team constantly learn from and improve its meetings.

To keep the project on track and focused on its objectives, we strongly recommend developing an improvement plan, such as the Basic Plan described earlier. An improvement plan serves as a guide and management tool for the project. The team leader and quality advisor should draft an improvement plan, then involve the full team and guidance team in refining and improving it.

Element 4: Team Development

The fourth key element of successful quality-focused project teams is a focus on the team itself. Any newly formed group must shift from a collection of individuals to a cohesive team if it is to function effectively. The members must establish methods of working and learning together. Team development is particularly important for a quality-focused project team improving an administrative process. Administrative projects generally involve change in how people do their work—changes that are difficult at best. Team members will be instrumental in developing broad-based understanding and support for the recommendations they develop.

The cornerstone of team development is how the team makes decisions. In traditional teams, and in most team members' experience, power and authority come with organizational rank and status. In a quality-focused project team, each member is there to contribute his or her particular expertise. Decisions are data-based rather than

status-based. It takes discipline and practice to work with this new approach to decision making.

Element 5: Process Focus

When we think about work we tend to think about individual tasks: putting labels on envelopes, filling out order forms, calling customers. Quality improvement project teams learn that every activity is part of a process, and there are thousands of processes in every organization. Thinking in terms of processes is perhaps the most profound change that occurs in the transformation to continuous quality improvement; project teams are a key vehicle for developing process thinking.⁵ People who view work as a series of processes understand how the quality of what comes out is largely determined by the quality of what goes in. The process perspective leads naturally to using methods for studying and improving processes. It is these methods that make quality-focused project teams more effective than the traditional "put good heads in a room together" approach.

Element 6: The Scientific Approach

The scientific approach is the core of quality improvement methods. This means systematically studying processes; making decisions based on data rather than hunches; looking for root causes of problems rather than reacting to surface symptoms; seeking permanent solutions rather than quick fixes.⁶ Some of the tools of the scientific approach, such as flowcharts, are closely linked to the process perspective discussed above. Other tools involve statistics and require a focus on data and measurement. The quality-focused project team's tool kit includes operational definitions, checksheets and other data gathering tools, and simple diagrams and charts for data display and analysis. When project team members collect and analyze data on a process, they begin to learn about variation and common and special causes.

C. Launching a Project

The basics of launching a project are the same whether you are in a manufacturing or administrative setting. For all quality improvement projects, managers must select the focus and draft a mission statement. The mission statement may be revised once the team studies it, but it is management's responsibility to start the team off in as clear a direction as possible.

Management must also choose the players: a team leader, who has responsibility for the process to be studied; a quality advisor (someone skilled in the tools of the scientific approach, interpersonal, meeting and project management skills, and training); and team members, who know the process from the perspective of workers, customers, or suppliers. Management must also ensure that the team is supported with time and resources for initial training and development activities. The quality advisor will deliver some of this start up training.

IV. CONCLUSION

People wrestling with problems in administrative areas need more information on how quality improvement principles apply to them. Many ideas used in manufacturing are directly applicable, but their use must be tempered by special attention to the people issues: the history behind a process, why it works the way it does, which people have vested interest in how well the process runs, how changes in the process may affect workers, how to create ownership and pride in the process operators and proprietors. Measurement issues are also particularly sensitive in administrative jobs since it is often the employee's performance being measured and not some gadget or part. Involving management and operators in the change process is critical to its success. The eight-step plan presented here can help people avoid the most common pitfalls when trying to change an administrative process.

V. ENDNOTES

1. The basic features of service and administrative processes are discussed in: Melan, E. H. "Process Management in Service and Administrative Operations." *Quality Progress*. June, 1985.
2. Project teams are like cooks: When they begin, they must follow recipes exactly to get a usable product. But with experience, they gain knowledge that lets them adapt recipes to suit their needs.
3. The IS/IS-NOT analysis comes from: Kepner, Charles H. and Benjamin B. Tregoe. *The Rational Manager*. New York: McGraw-Hill Book Co. 1965. (Chapter 5)
4. Scholtes, Peter R. and other contributors. *The Team Handbook: How to Use Teams to Improve Quality*. Madison, Wis.: Joiner Associates Inc. 1988.
5. Ibid, p. 2-2.
- 6 Ibid, p. 2-8

Baker, E. M. (Winter 1989). The evolution to total quality excellence. Dialogue, pp. 7-13. Available from E. M. Baker, Director, Quality Planning and Statistical Methods, Ford Motor Company, Detroit MI 48121.

Dr. Baker discusses several aspects of Ford's efforts to improve organizational quality. Among these are the beginnings of changes in organizational culture, an altered view of the customer, changes in the relationship between industrial customer and supplier, and the vital role of employees in the organizational improvement effort.

The evolution to total quality excellence

Edward M. Baker

**Director, Quality Planning & Statistical Methods,
Ford Motor Company**

As the battle for improved quality continues to accelerate among automakers worldwide, Ford Motor Company has made steady progress. According to recent consumer surveys, Ford's quality is now 60% better than in 1980. These improvements are at least partially responsible for Ford gaining two additional points of market share in 1987. In its advertising, the company places strong emphasis on product quality. One well-known slogan says, "For seven years running, the highest quality Ameri-

can cars and trucks." In this essay, Dr. Edward Baker, Ford's Director of Quality Planning and Statistical Methods, stresses continuous change as the key to high quality products. He comments that suppliers must understand the customer's needs and the customer must understand the supplier's capabilities. Without such cooperation, Baker adds, neither supplier nor customer will be competitive in the world markets of the future.



When Dr. W. Edwards Deming, the world-renowned quality expert, met recently with Philip Benton, president of Ford's worldwide automotive operations, he asked Mr. Benton what his job was. Mr. Benton replied, "I manage change."

Now that is not the answer one would have expected from a senior executive years ago. The job of management traditionally had been to maintain the status quo — to prevent change. Change was viewed as undesirable. Why? Because we assumed the business environment was stable.

Management's job, therefore, was to assure strict adherence to the standards and procedures of the company's systems.

We realized that we were not invincible. Our losses showed us how vulnerable we were to rapid external change, and how poorly prepared we were to deal with it.

The accuracy of that assumption began to be severely challenged in the decade of the 1970s, a difficult period for the U.S. automobile industry that was characterized by fuel shortages, government regulations of fuel economy, emissions and safety, inflation and recession. This was accompanied by two disturbing and related events:

- *Product quality of Ford (and the other domestic manufacturers) was stable. It did not get better and did not get worse; and*
- *During the same period, Japanese products showed continuous improvement.*

We realized that our eroding market share and immense financial losses in the early '80s were the price we were paying for our failure to recognize that customers were

becoming more discerning and demanding for quality, fuel efficiency, and price.

We were shocked.

We realized that we were not invincible. Our losses showed us how vulnerable we were to rapid external change, and how poorly prepared we were to deal with it. We began to recognize that the systems that served us well in the past would not be good enough for the future. If we continued to rely on current processes and systems, performance would not just remain the same — it would get worse and worse.

The new economic age

The crisis we experienced was the result of trying to maintain the status quo when everything around us was changing. Our existing management systems were not appropriate for the "new economic age" — Dr. Deming's term for the rapidly changing environment in which we have to do business. We learned that we needed to find ways to thrive in a world of accelerating external change. We did not know exactly how to do this, but we did know that success would be determined by the way we defined quality, and how we produced those quality products and services.

We are now in the latter part of the '80s and Ford has become a leader in quality and profits. Why? Because Ford Motor Company is undergoing a major worldwide transformation. I am not speaking of a transformation in technology, although that certainly is occurring. Rather, it is a transformation of culture. Ford in 1988 is not the same company it was in 1983. And in five years it will be a different company than it is today.

The change I am speaking about is almost invisible. It cannot be seen by looking at the buildings and facilities. And even though our vehicles are very attractive, I am not talking about the appearance of our cars and trucks.

The changes are taking place in the way we think.

It will be evident in what we believe and value, how we behave, work together and treat one another, both inside the company and in our external relationships — especially with customers. Certainly there are tools and methods that people must learn to use. But the tools and methods are working only because the environment supports everyone's involvement in improvement.

One of the very important agents of this change was Dr. Deming. In mid-1980, as we were working our way toward losses of billions of dollars, some of our people saw the television documentary, *"If Japan Can't Why Can't We?"*

Great tribute was paid to Dr. Deming, and as a result it was suggested that we bring him in to teach us what he taught the Japanese. We thought perhaps one or two weeks would be enough. But Dr. Deming was not interested in visiting Ford until we convinced him that the company was really focusing on quality, and would do what was necessary to bring about meaningful change.

A cultural transformation

Dr. Deming first visited Ford in January 1981. (He was much younger then — only 80 years old.) We wanted to talk to him about quality; he wanted to talk to us about management. We wanted to know what programs would work; he wanted to discuss senior management's vision for the company.

It took time for us to understand that he was proposing a profound cultural transformation. Proposing is actually too weak a word to describe his message. He viewed cultural change as a matter of life and death for North American firms, not just for Ford, but any enterprise. What was required was a common sense of purpose and direction. And it had to start at the top, and be led by the top.

When Dr. Deming first asked our top management whether Ford had constancy of purpose, they were very surprised that he would ask such a question. After all, Ford had been in business for over 75 years.

Surely we had constancy of purpose. But we soon understood what he meant.

We realized that Ford actually did not have a written statement of purpose and principles to guide every employee in the contribution to the accomplishment of that purpose. People can't share in the purpose and the goals of the company if they don't know what these are. So we started a process to define the kind of company we were and would like to be. Company management, worldwide, participated in the discussions that led to the company's statement of its mission, values and guiding principles. This took about one and a half years to do.

***Ford Total Quality
Excellence is a concept
that emphasizes the
importance of quality in
everything that we do.***

Here is what Ford Chairman Don Petersen said about the broad-based development of the mission, values, and guiding principles:

"Dr. Deming, through his 14 Points, did a wonderful job of initiating and agitating the thought processes among a wide array of people at Ford Motor Company as to whether we truly had a defined and communicated constancy of purpose."

Our constancy of purpose is embodied in our statement of mission, values, and guiding principles (*figure one*). Our guiding principles provide a vision of how we would like to behave. These are of equal importance, interwoven and inseparable. All are essential.

Ford's definition of quality is shaping the behavior of its people. Ford Total Quality Excellence is a concept that emphasizes the importance of quality in everything that we do. It means meeting internal and external customer needs and expectations over the life of the product or service at a cost that represents value.



Mission

Ford Motor Company is a worldwide leader in automotive and automotive-related products and services as well as in newer industries such as aerospace, communications, and financial services. Our mission is to improve continually our products and services to meet our customers' needs, allowing us to prosper as a business and to provide a reasonable return for our stockholders, the owners of our business.

Values

How we accomplish our mission is as important as the mission itself. Fundamental to success for the Company are these basic values:

People — Our people are the source of our strength. They provide our corporate intelligence and determine our reputation and vitality. Involvement and teamwork are our core human values.

Products — Our products are the end result of our efforts, and they should be the best in serving customers worldwide. As our products are viewed, so are we viewed.

Profits — Profits are the ultimate measure of how efficiently we provide customers with the best products for their needs. Profits are required to survive and grow.

Guiding Principles

Quality comes first — To achieve customer satisfaction, the quality of our products and services must be our number one priority.

Customers are the focus of everything we do — Our work must be done with our customers in mind, providing better products and services than our competition.

Continuous improvement is essential to our success — We must strive for excellence in everything we do; in our products, in their safety and value — and in our services, our human relations, our competitiveness, and our profitability.

Employee involvement is our way of life — We are a team. We must treat each other with trust and respect.

Dealers and suppliers are our partners — The Company must maintain mutually beneficial relationships with dealers, suppliers, and our other business associates.

Integrity is never compromised — The conduct of our Company worldwide must be pursued in a manner that is socially responsible and commands respect for its integrity and for its positive contributions to society. Our doors are open to men and women alike without discrimination and without regard to ethnic origin or personal beliefs.

Figure One

The *Total Quality Excellence Policy Letter* states the fundamental precepts of Ford's Quality Culture:

- Quality is defined by the customer.
- Quality excellence can best be achieved by preventing problems rather than detecting and correcting them after they occur.
- All work that is done by company employees, suppliers and dealers is part of a process. Each person can influence some part of that process and, therefore, affect the quality of its output and the ultimate customers' satisfaction.
- Sustained quality excellence requires continuous process improvement.
- People provide the intelligence and generate the actions necessary to realize continuous improvement.
- Each employee is both a customer and a supplier, and as such, has a right to expect good work from others and also has an obligation to contribute high-caliber work to others.

In order to achieve Ford Total Quality Excellence we are trying to move from defect detection, with its heavy reliance on inspection and checking, to defect prevention — doing the right things, and doing them right consistently. Then, from those stable, consistent processes we are able to plan ways to improve.

Changing old ways

This new way of thinking about quality was an important step in our cultural change. Traditionally, our definition of quality was very narrow. First, it had been focused inward, not on the customer. Quality was considered to be attained when parts or products were produced that met engineering tolerances or specifications. Prints and specifications usually were a compromise between the engineer's concept of what the

customer should have, and what manufacturing claimed they could produce. In addition, the inspector was the surrogate of the engineer.

We are striving to provide product and service that goes beyond the customers' expectations and imagination.

The engineer decided what the customer wanted, and the inspector acted on his behalf, sorting out those parts that did not meet specifications. Second, it did not involve the rest of the functions of the enterprise. Quality was interpreted to mean only product (hardware) quality.

We concluded, as a result of our difficulties in knowing what the customer wanted and meeting those wants, that quality had to be defined from the customer's viewpoint. This meant we had to broaden our internal definition of quality from a negative one — the absence of defects and problems — to a positive one, which focused on the production of value in the form of features and performance that would delight and excite the customer.

Understanding the customer

Imagine ordering a meal in a restaurant by telling your waiter all the things you do not like (i.e. specifying the defects). The waiter will still have difficulty in knowing what you do want. It could take several days before you were served the meal you wanted. If the waiter knew what the customer did want, the restaurant would be more likely to satisfy the customer, with little waste and at lower cost.

We discovered that we had to know and understand our customers thoroughly. Quality had to be more than an absence of defects. The absence of defects won't guarantee customer satisfaction. It is what the customer expects anyway. We are striving to provide product and service that goes beyond the customers' expectations and imagination. We want customers to be more than satisfied. We want them to be excited and delighted and feel that they are

getting tremendous value for the price they pay.

How are we making this happen? To promote the activities that lead to improvement and innovation, we are taking a new look at the work of employees. ~~We view every~~ employee as participating in a process. A cornerstone of Total Quality Excellence is the involvement of all employees in the improvement in the processes in which they participate.

Let me give you one example. One of our early efforts at process improvement involved our desire to improve the quality of our products launched, by reducing the errors that were present in the first dies, tools and fixtures of any program. At the same time, we believed that there was significant opportunity for reduction in time and cost of the tooling process. We put together a group of experts on computer-aided design and computer-aided manufacturing to do this.

A cornerstone of Total Quality Excellence is the involvement of all employees...

However, we soon realized that no one knew how the whole process worked from the initial clay model of a fender to a completed die ready to produce the stampings. We didn't even know everyone who should be involved.

It took a group of about 40-50 people six months to develop a flow chart of the basic steps. We then saw that some of the steps added little, if any, value. As a result, 40% of the steps are now being eliminated and many more are being changed. It is estimated that the cost and time will be reduced by about 20%. Sources of error will be reduced significantly, and the quality of first dies are expected to be improved significantly.

We are doing similar things throughout the company. In finance, in plant engineering,

in our medical, health and safety processes, in product development — everywhere:

Quality relationships

~~Process~~ improvement requires teamwork inside the company, and with our suppliers and dealers. Let me give you a perspective on teamwork based on an analogy from a brilliant systems thinker, Russ Ackoff.

Let's say we wanted to build the best performing car. We could bring every competitors' model into a garage. Our engineers would then test and inspect all of the cars, noting which has the best transmission, best radiator, and so on. Then the best parts would be taken off the cars and assembled into a new vehicle.

How good do you think this car would be?

Even if you could get the parts to fit, would the car run?

Probably not.

Why? Because the quality of a mechanical system occurs at the interfaces between systems components and in their contribution to the larger system in which they function. The parts of the system do not have value by themselves. They have value only in the way they relate to each other and serve the whole. Thus, to work as a team, people must know how they relate to each other as suppliers and customers.

Quality relationships make quality products. A supplier-customer view of the relationships inside the company is helping to shed light on why things don't always go well. Things such as:

- Why there are rework, errors, lack of traceability of paperwork;
- Why bills are not paid on time;
- Why schedules are not met;
- Why engineering changes are not entered in the appropriate documents;
- Why in fact excessive engineering changes occur in the first place; and
- Why there is waste of the organization's resources instead of added value from people's efforts.

For instance, think of the difficulties of communicating in top-down organizations. Consider an organization with six levels below the senior executive and a span of control of three. This makes 1,093 people. More importantly, there are 586,778 potential two-person interfaces that represent potential internal supplier-customer relationships. These 1,093 people depend on one another to get their job done, but their interdependencies are not explicit.

The supplier must understand the customer's needs, and the customer must understand the supplier's capability to provide products and services.

How can they be explicit when there is such complexity? How can people know where they fit in to the total scheme of things, into the big picture? How can they know who receives the outputs of their process, or who supplies the inputs (information, materials, etc..) which enable them to do their work? If quality occurs at the supplier-customer interfaces, then suppliers and customers must be able to engage in face-to-face communication.

The supplier must understand the customer's needs, and the customer must

understand the supplier's capability to provide products and services. Both must work together to improve that relationship, thereby improving the value of their contribution to subsequent process stages and, hence, to the larger system.

I have mentioned all of this to reinforce the idea that we feel that internal and external supplier-customer partnerships, teamwork, and cooperation are the only ways to be competitive in the future. The desire for teamwork is supported by a methodology that enables people to understand the system in which they work and improve that system. Statistical methods, process flow charts, and other methods are effective when they are applied within the context of planned improvement.

The Deming/Shewhart Cycle (Plan-Do-Study-Act) helps us manage change and effectively apply these tools. It is used to help us anticipate — as well as influence — future changes in our environment.

We are learning to deal with change in more imaginative and more efficient ways. Supplier-customer partnerships in the quest for Total Quality Excellence will produce success for all of us.

When Baker was studying for his MBA, a professor warned him that he didn't have the personality to be an accountant...so he says he decided to become a statistician instead.

Artinian, H. L., & Baker, E. M. (1988). Improving quality: The critical hidden link. Paper presented at the 1988 ASQC Quality Congress Transactions, Dallas, TX.

The authors assert that since only a small portion of organizational resources are actually devoted to the manufacturing function, the greatest potential for improvement in organizational quality resides in the administrative, service, and support functions of the organization.

The article describes the formation of a cross-functional team at Ford to study and improve its claims processing system. The methodology used is consistent with the articles described in the previous section. The importance of operational definitions is stressed.

The results illustrate the tremendous opportunities that exist for organizations that strive to improve their service, administrative, and support functions.

1988--ASQC QUALITY CONGRESS TRANSACTIONS--DALLAS

IMPROVING QUALITY: THE CRITICAL HIDDEN LINK

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ABSTRACT

This paper describes a case study to illustrate the Ford Motor Company commitment to working continuously to achieve excellence in all areas of the business. Top management has recognized that, in order to compete effectively in global markets, major efforts to improve service quality and productivity has to be implemented even during times of apparent prosperity. To accomplish this, major changes in relationships and methods of operating both between and within the organizational components is required. Changes described in this paper were brought about by utilizing statistical methods within the context of the Deming philosophy to assess the present operating conditions and identify potential areas of improvement. The case focuses on the importance of operational definitions as a critical link in improving quality in any processing system.

TEXT

North American business is faced with a marketplace of accelerating change in customer needs, hopes and expectations. This presents a challenge to the enterprise that cannot be met with a chaotic scramble to beat the competition. Rather, it requires coherent plans and actions that align the firm's definition of quality with that of the customer (i.e., matches the voice of the process with the voice of the customer).

In the manufacturing enterprise, quality traditionally has been associated with the product characteristics that the engineers and developers could see, touch and feel. However, in most firms, resources dedicated directly to manufacturing (those that interface with the product during production) are a small fraction of the total resources needed to develop, produce, sell, deliver and service the product to the final customer. The strategy to improve customer satisfaction and win customer loyalty must encompass all of the functions of the enterprise. The viability of many firms will be decided during the 1990's on the administrative, support and services battleground as the competitive war advances on all fronts. Customer-perceived quality resides not only in the product, but in the entire package of product and services in which the product is embedded. This is true whether or not the processes that produce those products and services are visible to the customer.

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The Chairman of the Board of Ford Motor Company recognized this when, on a tour of the Company's newly launched Order Processing Center in 1984, he discussed the possibility of applying Dr. Deming's management principles to the administrative and service environment. The Order Processing Center (OPC) is situated on the bank of the Detroit river high in the shimmering towers of the Renaissance Center. The OPC is a centralized facility incorporating advanced communications technology to enable the Company to effectively respond to dealer inquiries related to vehicle orders, sales transactions and the processing of claims for incorrect/damaged vehicles.

One of the authors, acting as an internal consultant, met with the OPC's top management to develop a quality improvement plan that included lengthy interviews with a diagonal slice of the organization (one-on-one and in groups), identification of the major internal suppliers and customers of the OPC and their interrelationships, and potential areas of improvement. The claims processing system was selected in order to improve the OPC's capability to effectively resolve an unfortunate situation for dealers and customers and re-strengthen relationships that could have deteriorated because of the need to file a claim in the first place.

A cross-functional team was formed from various Company divisions and the current process was documented (Figure 1). The team:

- Identified the dealer as the primary internal customer; i.e. the user of the output of the claims processing system.
- Defined the claims processing system's output as a decision on a submitted claim; i.e. approval/denial of the actual claim submitted.
- Agreed that the trigger of the macro process was the identification of a vehicle concern at dealer check-in.
- Developed the outcome to be improved: reduction in the number of dealer claims received by the OPC for "incorrect/ damaged vehicles."
- Selected the claims systems supervisor as the process owner (i.e. the individual with the greatest equity and authority to make appropriate system changes based on the team's recommendations).

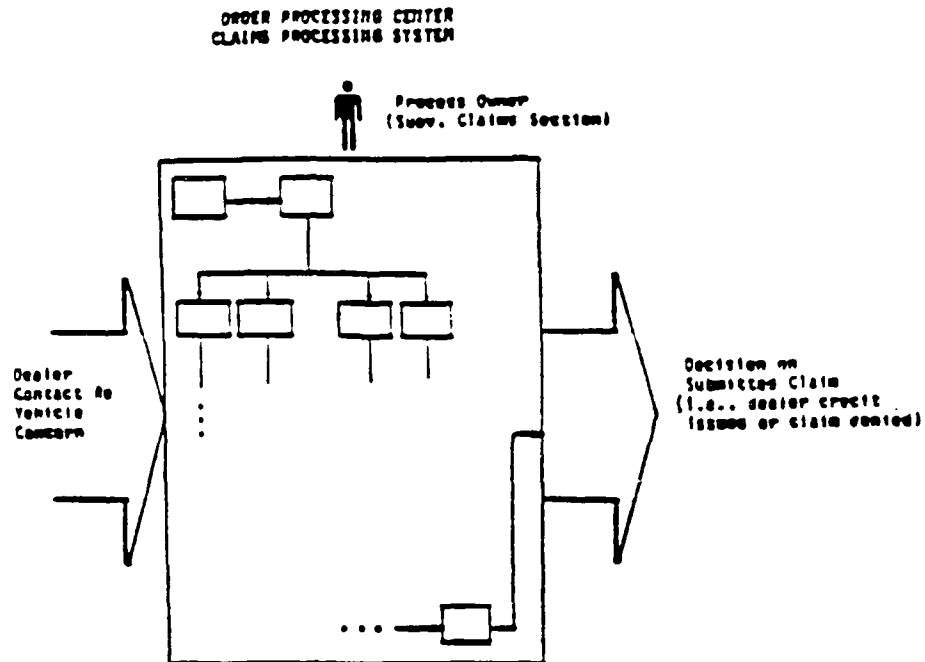


Figure 1

The diagnostic phase proceeded with development of a process flow diagram of the claims system in sufficient detail to understand how resources move through the system, what the sequences of tasks and activities are and to make explicit the various interfaces within the entire process. This took several weeks to complete as team members sought to clarify the roles and responsibilities of all known internal suppliers and customers.

The team applied the concept of value added as they analyzed the current flow. Many processes, particularly in the administrative, service and support environment have evolved slowly over many years. Stages are inserted into the process in a well meaning attempt to respond to specific concerns and disruptions. For example, additional levels of approval are added to maintain tighter financial control and ensure expenditures remain within budget. Additional review and inspection means that management does not trust the process to do its job. These stages add no value to the customer. They are there to cope with incapable upstream processes. Without an overall process approach to the system, the complexities remain hidden and opportunities for improvement are not obvious. With this in mind, the team identified several non-value adding stages that had been required due to inconsistent policies/procedures by U.S. assembly plants. Discussion with the operating components revealed much of the differences had been established to respond to requirements to meet plant financial objectives.

But the real breakthrough was made in the next phase of the analysis. The continuous improvement process model (Figure 2; see Baker and Artinian, 1985 for more detailed discussion of the process model) was applied to each stage of the claims system. A question

arose about allocating the type of claim to the various claim categories: How does the claims analyst decide which type of claim it is? Since only the "not built as ordered" category was handled by the OPC, a decision to allocate to one of the other categories meant a delay in any credit resolution of the concern in the eyes of the customer.

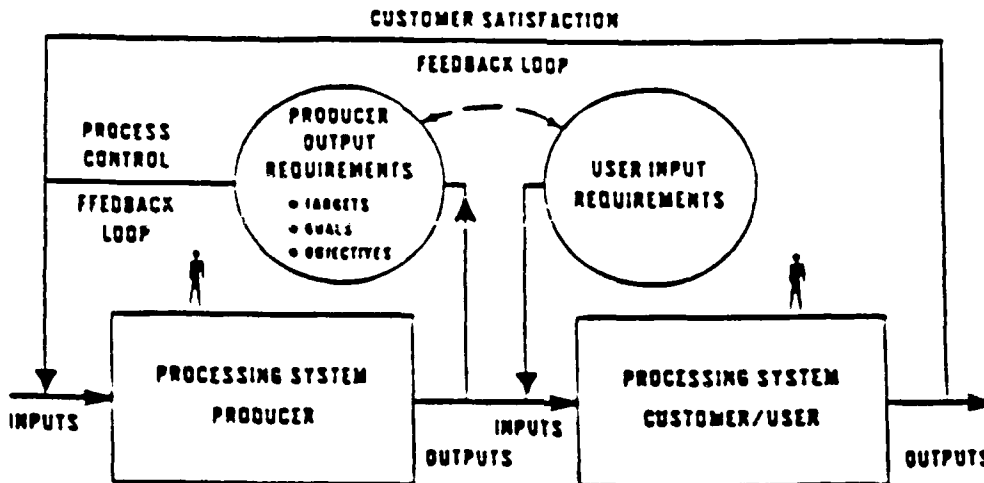


Figure 2

Further discussions led to still more questions about how the process really functioned at this stage. Analysts indicated that a great deal of time was spent investigating each claim to determine its merit, but that frequently it was still not clear whether the decision should be made in favor of the dealer. Worse still, employees who made a prior approved decision on a claim may have the same decision on a similar claim by a different dealer overturned by management. This inevitably led to confusion by many analysts who couldn't see a difference in the cases. In an effort to identify why all this was happening, the team members were asked, in a group meeting, to write down the definition of a vehicle that had incurred "loss or damage in transit." After several attempts, it became clear that there was no agreement on this first of four categories of dealer claims.

But what about the dealer? Discussions with several dealer principals in dealerships in California, Texas, Montana, Michigan and Canada revealed an interesting pattern. Several scenarios were provided to them in which vehicles with potential claims were dropped at their dealerships and they were asked what action they would take. The scenarios were carefully crafted to combine a mix of clear-cut (or so it was believed) and vague conditions. In only a fraction of the cases, according to team members, was the correct action cited despite the best of intentions.

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It was becoming obvious that the real upstream root cause of much of the system dysfunction was due to the lack of operational definitions for each claim category. Despite every person in the process doing his or her best, the system was suboptimized. The dealer, claims analyst, and supervision were all attempting to perform to the best of their knowledge and ability within the system as it existed. This matching of producer output and user input requirements through operational definitions is critical if the customer is to perceive a high quality product or service (Figure 2). These critical links had not been established through a mutual understanding of what was required and what would be delivered (Figure 3).

Armed with the knowledge of where the process breakdown was occurring and what changes were needed in the system, the team set out to develop operational definitions of each of the four claims categories. Input was solicited from all areas that had even a peripheral interest in order to ensure nothing would "fall between the cracks." Continuous improvement requires many iterations through the PDCA cycle and this effort was no exception. One of the first steps was to identify the National Dealer Council as a customer in the planning stage in order to get their support and assistance. If it wasn't appealing to them, chances were good the national dealerships wouldn't like it either. After six months of intensified effort, the team completed a first draft of the definitions together with the specific Company contacts for each category.

There were other improvements as well. The old system required that all missing items on a vehicle at drop-off must be annotated on a bill of lading. With the manufacturing technological advances in recent years, this was a physically impossible task since many vehicle options cannot be seen easily from the outside or, if they can, cannot

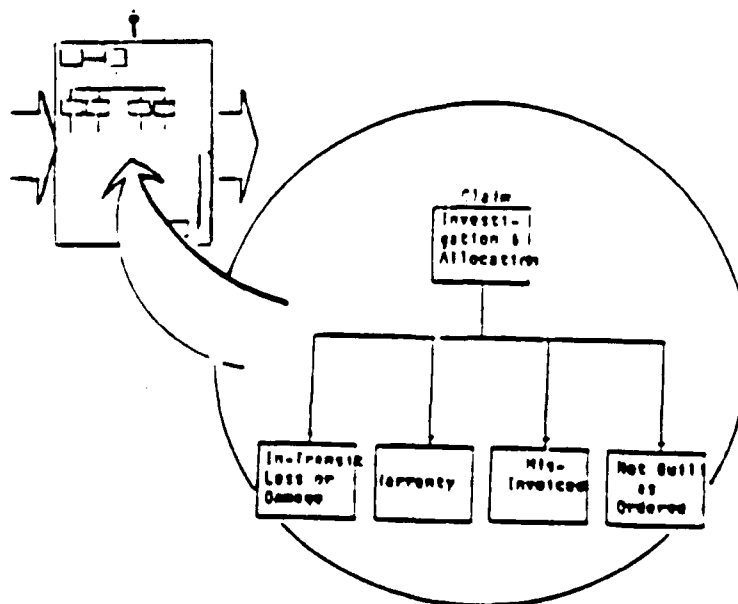


Figure 3

be easily identified (regular versus heavy duty batteries, for example). The new system reduced the extensive list of items required for annotation from over 100 to just 18 which clarified responsibilities, eased the dealer burden, and improved the quality of service to the customer.

Presentation of these proposed changes of the system to the National Dealer Council received a very positive response. Several suggestions incorporating the dealer's viewpoint were made, and a new brochure and pocket card were issued to the entire U.S. dealer network. The development of the pocket card was necessary to meet the need at the dealership level of reaching the individual who would be the first decision-maker on the need to submit a claim.

Statistical monitoring of the system shows a process in transition to fewer claims (Figure 4). Additional measures which demonstrate reduced time to process a claim also point to a higher quality service system that increases customer satisfaction.

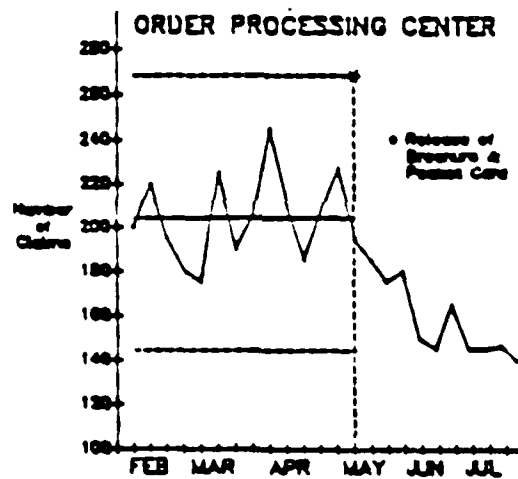


Figure 4

The experience of the claims processing system illustrates very clearly the tremendous opportunities that await organizations who can identify processing systems that lack operational definitions. It is a critical hidden link that is all too frequently either forgotten or assumed to exist, particularly in administrative, service and support systems.

The Order Processing Center has continued to expand the application of process improvement methodologies into other areas such as incoming dealer calls, order selection and option changes. Feedback loops of customer/dealer concerns are being established from the OPC to the assembly plants to provide a direct and rapid link and enable the Company to translate the voice of the customer to the voice of the process at a rate unsurpassed in the industry.

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CONCLUSION

The hallmark of a customer-driven company is one which recognizes that every employee at every level of the organization is a supplier and a customer. Company systems are interdependent and improvement comes from recognizing this and working together to identify causes for problems that result in dissatisfied customers. Operational definitions are crucial in ensuring that any processing system will produce high quality as perceived by the customer. In the final analysis, the one who meets and exceeds the needs and expectations of the customer...wins.

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Orsini, J. N. (May 1985). The quality-productivity connection. United States Banker, 96(5), 86-87.

In this brief article, Dr. Orsini applies to banking the theory and tools for improvement of processes described in previous sections. The distinction between common and special causes of variation is lucidly explained, as is the responsibility of management to understand, analyze, and improve the system in which employees work.

The Quality-Productivity Connection

By Dr. Joyce Nilson Orsini, Vice President and Chief Statistician
Savings Banks Association of New York State

Standing over a typist urging "faster, faster" will not produce results more quickly. Demanding that tellers handle 20 percent more customers per hour, and that they not produce any errors, will result in frustration and failure.

There are some things that are within an employee's control and there are some things that, no matter how hard the employee tries, can never be accomplished alone. Experience shows that only about 10 percent of the problems in a bank can be corrected, changed or improved by an employee, or isolated as one-of-a-kind problems. The other 90 percent requires management decisions to change a rule, a process, a method of processing or a system.

Until management understands and acknowledges this fact, and takes responsibility for those problems only they can solve, there is little hope for improvement in quality of product and service at a bank. This doesn't mean that management is the cause of problems (although that may be), it means only that a management decision is required to show improvement. The solution is not always easy, either. Often, improvement comes about through a series of changes with careful monitoring after each change.

Solving Problems

The first step in tackling any problem is to be able to recognize when a problem arises from a special cause and when it arises from a common cause.

A special cause is an isolated event, resulting from an unusual circumstance. Some examples: a computer breakdown, an employee's ill health, a fire, a machine that becomes so worn that it results in errors, an employee who is not suited to a given job.

A common cause results from within the system and will continue to cause a problem until the system is changed. Some examples: inadequate employee training programs, unclear procedures, inconsistent requirements, deficient employee tools or working conditions, following a defined process that creates a problem.

If error rates are high or customers complain about long lines, it is all too easy to blame an employee, even though the cause may be a system problem (common cause). Blaming an employee, when it is not his fault, is the single biggest management error we make.

Simple statistical techniques can help determine when an event is the result of an isolated special cause and when it results from a common cause. One such technique, a control chart, will show if a system is in statistical control, and will indicate the variability in a system that results from the elements of the system itself. Statistical control means that you have a system (the process is not chaotic), and that the variability in the system due to common causes can be measured; changes in the system would be required to effect improvement.

One bank found that a chart of the error notes for deposit transactions showed that 15 to 40 percent of the deposit transactions had errors, yet the system was in a state of statistical control. The average error rate was 27.5 percent. This meant that, barring any change in the system, the bank could expect an average of 27.5 percent of the transactions to contain errors in the future, and that the error rates from day to day would range between 15 and 40 percent. Errors on deposit transactions included (but were not limited to) wrong dates, deposit amounts listed on the wrong lines, teller count of cash entered in wrong columns, incorrect totals, teller stamp missing, deposit credited to wrong account, wrong amount credited, deposited checks not marked with account number and missing information.

Clearly, this was unacceptable. After careful consideration of 32 factors related to the process, the bank revised its procedures slightly, changed the format of the deposit ticket and beefed up its training program for tellers. The result after six months: The average error rate is under 1 percent of the transactions, and the range of variability of errors from day to day is 0 percent to 1.5 percent. The bank is still not satisfied, and is working on additional process im-

provements to get the errors down to zero.

In its total quality-improvement program over the past 18 months, this bank has tackled more than 200 problems resulting from common causes, has implemented changes in most of the processes studied so far, has seen dramatic improvement in error rates in all departments, and has already seen results on the bottom line. Moreover, customers' complaints are seldom received now, instead, compliments come often. Employee morale is high, and turnover and absenteeism have dropped sharply.

The key, according to the CEO, is "total involvement of all officers and employees." If the commitment of senior management had not been strong, there is no doubt the program would have failed. A major time commitment must be made throughout the organization. Improvement in delivery of product and service to your customers has to be the number one priority.

An improvement in the quality of a bank's services results in less time spent in correcting errors, tracing lost documents, checking reference books or asking colleagues for the correct procedures to handle a particular transaction. This previously lost time can then be used to provide quicker, better service to customers.

Before embarking on a quality control program, an analysis of the bank mentioned above revealed the follow-

ing percentage allocation of man-hours for its 268 employees:

Delivering service directly to customers	33 %
Back-office productive work ...	28 %
Back-office error tracing and rework of errored documents	32 %
Other	7 %

Total man-hours	100 %
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After 1-and-a-half years in the quality

control program, the percentages were:

Delivering service directly to customers	48 %
Back-office productive work ...	32 %
Back-office error tracing and rework of errored documents	11 %
Other	9 %

Total man-hours	100 %
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Eighteen months after the start of a quality control program, the back-office error tracing and rework dropped from 32 percent to 11 percent of total man-hours. Twenty-one percent of total man-hours (the equivalent of 56 full-time employees) have now been added to productive service. And, productive service now accounts for 89 percent of total man-hours, instead of 68 percent, an increase of 31 percent in productivity, which resulted in increased customer service and satisfaction, and increased profits.

Throughout the early months of the program, the CEO was constantly amazed at how much the employees knew about the problems at the bank. Some of the best ideas for system improvement and process change came from nonmanagement employees. The employees had been living with the problems, trying to make do with inadequate instruction and training, and in some cases had devised their own systems for handling transactions. For the first time, management understood the need for communication. Obviously, they had been remiss, so employees improvised. They did the best they could with what they knew. Employees as a rule want to do a good job. But wanting to do a good job is not enough — knowledge and training are necessary to do the job properly. It is up to management to see that training programs are adequate and current.

A total quality control program requires a new management attitude towards the bank and the worker, a long-term commitment and hard work. The resultant improvement in quality of service and product, results in an increase productivity and higher profits. ■

McDaniel, D. M., & Doherty, L. M. (February 1990). Total Quality Management case study in a Navy headquarters organization (Tech. Note 90-10). San Diego: Navy Personnel Research and Development Center.

This report documents the efforts of a Navy headquarters organization to implement Total Quality Management (TQM). It describes the implementation plan and the selection of the engineering change proposal (ECP) as the first process to undergo continuing improvement using TQM methodology. The report chronicles the development of a TQM Executive Steering Committee and Quality Management Board (QMB), the education and training process, and the selection of the ECP process for analysis. Results of data analyses by the QMB are presented along with a description of continuing efforts. Recommendations concern process definition, work prioritization, just-in-time training, emphasis on immediate results, and documentation of future actions.

**Total Quality Management Case Study
in a Navy Headquarters Organization**

Delora M. McDaniel
Linda M. Doherty

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Organizational Systems Department

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Approved for public release;
distribution is unlimited.

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INTRODUCTION

Effective implementation of Total Quality Management (TQM) to improve quality and productivity is based upon the philosophy and management principles of W. Edwards Deming. Although some private sector companies, such as Hewlett-Packard and Nashua Corporation, have demonstrated successful application of his principles and methodologies, there are only a few government agencies to date that have moved ahead with the same degree of commitment.

RADM J. Kirkpatrick, former Assistant Commander for Fleet Support and Field Activity Management (AIR-04), Naval Air Systems Command (NAVAIRSYSCOM or NAVAIR), committed his organization to implementing this management approach. He was succeeded in February 1989 by RADM J. F. Calvert. To aid AIR-04 in its undertaking, the Navy Personnel Research and Development Center (NAVPERSRANDCEN or NPRDC) provided them with TQM awareness and implementation training as well as consultation services. During FY89, NPRDC researchers worked closely with AIR-04 management as implementation efforts began.

TQM Infrastructure

An organizational infrastructure based on cross-functional teams is basic to NPRDC's TQM implementation model. An Executive Steering Committee (ESC) exists at the highest level of the organization. This is the policy-making board and consists of the highest ranking executives within the organization. It is a permanent board whose job is to direct the quality improvement effort. The ESC charts Quality Management Boards (QMBs) (one or more) to work on significant work processes within the organization. This tier generally consists of middle managers who have "ownership" of a process. The QMBs are also permanent, established to ensure continuous improvement. The QMBs charter Process Action Teams (PATs), selecting members from among workers who work in and have knowledge of the process. These teams will disband once they provide the QMB with the data necessary for continuous improvement efforts.

This case study documents the work completed during FY89 by AIR-04's first QMB and the first process chosen for continuous improvement, the engineering change proposal (ECP) process.

Organizational Overview

NAVAIR provides the fleet and operational forces with aviation weapons systems and equipment. Headquartered in Washington, D.C., NAVAIR has approximately 48,000 military and civilian employees with an annual operating budget of over 16 billion dollars. The headquarters staff encompasses 23 functional areas and employs approximately 3,400 people.

AIR-04, a NAVAIR headquarters subordinate group, has 16 functional areas employing about 600 employees. The AIR-04 mission is to support the fleet and be world leaders in the life

cycle support of naval aviation weapons systems. Both NAVAIR and AIR-04 recognize the fleet as their ultimate customer.

AIR-04 TQM IMPLEMENTATION

ESC Development

The ESC was formed in January 1988. Members include the Assistant Commander, AIR-04; Deputy Director, AIR-04A; Deputy Assistant Commander for Logistics, AIR-41; Deputy Director, AIR-41A; Deputy Assistant Commander for Field Activities, AIR-42; Deputy Director, AIR-42A; Deputy Assistant Commander for Depots, AIR-43; and Deputy Director, AIR-43A.

NPRDC provided the ESC with educational sessions that initially focused on top management's "new job" in TQM. Sessions were devoted to the (1) rationale and necessity for writing a mission statement and guiding principles; (2) description and rationale for the QMB structure; (3) short-term (1-2 years) training requirements for TQM; (4) NPRDC's process improvement model (PIM), which expands Deming's PDCA cycle;¹ and (5) the short-term pilot projects approach, which includes a methodology for selecting a process.

Process Selection

Following the training session on process selection, each member was asked to bring a list of candidate processes to the next ESC meeting. Through group consensus, a final list was developed. It included:

- o technical directives
- o bulletins and airframe changes
- o budget development
- o contractor support service contracting
- o employee professional development
- o development of requests for proposals
- o engineering change proposals
- o communication and distribution system
- o travel orders and close-out vouchers
- o government-furnished equipment management

¹Based on the scientific method, Deming's Plan-Do-Check-Act (PDCA) cycle provides a systematic approach to problem solving that is basic to NPRDC's TQM implementation and process improvement models.

The ESC members agreed that the process problem(s) cited in this first list had to be solvable, while the processes themselves had to be visible, important, and cut across internal AIR-04 organizational boundaries.

From this list of candidates, a process was selected for attention, again by group consensus. This time the most important consideration was whether or not AIR-04 controlled a major portion of the process. Those processes that were under AIR-04 control were then rated individually and anonymously by the ESC members as either High (4), Medium (3), or Low (2), based on the following questions:

1. Could the process problem be solved or improved in a reasonable length of time?
2. Was it measurable?
3. Could improvement be made in less than one year?
4. Does the process have visibility throughout the organization?
5. How important is this process to our operation?

Once the rating was complete, final selection was by secret ballot. The group reached strong agreement on its first choice, that of the engineering change proposal (ECP) process.

Thus, 9 months after being formed, the AIR-04 ESC created its first QMB to tackle this first process. The ECP process was chosen because of its importance and visibility, both internally and externally. The ECP process is complex and requires significant time for approval. AIR-04 was particularly interested in time reduction and streamlining the approval process.

Establishment of the ECP QMB

The AIR-04 ECP QMB was officially established in November 1988, and ultimately assigned a charter signed by AIR-04 RADM J. F. Calvert. AIR-04A Deputy Director Paul Harner was named the linkpin between the AIR-04 ESC and the AIR-04 ECP QMB. He recommended that Paul Kovalsky, AIR-411A, be named Chair because of his knowledge and resourcefulness. The ESC supported this choice. The ECP QMB Chair then selected a board member from each of the AIR-04 functions, based on their knowledge of and experience with the ECP process. These functions are AIR-4104, AIR-410C, AIR-41223A, AIR-41831F, AIR-41723, AIR-433A, AIR-55211. Two AIR-04 logistics interns were assigned data analysis. This Board also includes one voluntary member from AIR-05 (engineering) who coordinates efforts between AIR-04 and AIR-05. In the spring 1989, a facilitator from AIR-4183 was selected by the ECP QMB Chair from a list of trained and available NAVAIR facilitators. Members are listed in Appendix A.

Coordination Between NAVAIR and AIR-04 ECP QMB

NAVAIR initiated formal TQM implementation organization-wide in October 1988, with the establishment of its ESC. As a result, the commander-level ESCs (e.g., AIR-04) were designated as "Group QMBs" whose functions are to charter QMBs and provide resources within their groups. In January 1989, the NAVAIR ESC chartered four QMBs, one of which focused on the ECP process. The NAVAIR ECP QMB included the Chair and two other members of the AIR-04 ECP QMB, as well as representatives from AIR-05 (engineering) and AIR-102 (configuration management and aircraft modification). This QMB has policy-making responsibility and authority for the entire ECP process in NAVAIR, with Group QMBs responsible for processes within their own groups.

QMB Education

All QMB members attended a 1-day awareness and 1-day implementation seminar conducted by NPRDC at AIR-04. NAVAIR training was provided by the Paul Hertz Group; it included a 3-day TQM awareness/implementation seminar, a 5-day executive orientation program, and facilitator training. Some of the QMB members had only the NPRDC training, while others had both NPRDC and Hertz training.

The Paul Hertz Group approach for process improvement embraces five stages: 1) create a positive environment; 2) identify process objectives; 3) identify measurement characteristics; 4) manage process variation; and 5) improve the process. In the Hertz process improvement model, management is largely responsible for Stage 1, creating a positive environment. This is comparable to Deming's Principle 8, Drive Out Fear. (See Appendix B for a list of Deming's 14 Principles.) A Process Improvement Team (equivalent to the QMB in the NPRDC model) then concentrates on the remaining four stages and passes through four "summits" (identified with each stage) in reaching its goal--an improved process. These four stages are similar in concept to the Deming PDCA cycle, which is the foundation of the NPRDC implementation and process improvement models.

ENGINEERING CHANGE PROPOSAL (ECP) PROCESS

ECP Process

An ECP is a proposal for a configuration change to existing operational equipment, including aircraft, engines, missiles, and components. These changes can be for increased safety, improved operations, or general improvement efforts. The ECP process itself is a complex administrative procedure that crosses several functional areas. While most of the functional areas are located at NAVAIR headquarters in Washington D.C., two are located in Philadelphia: technical publications at the Naval Aviation Technical Service Facility (NATSF)

and supply at the Aviation Supply Office (ASO). This necessitates moving the ECP package from one location to the other and back again. The instructions for ECP processing are found in NAVAIRINST 4130.1B, 23 April 1986.

Generally, a change request that generates an ECP will originate in NAVAIR. However, unsolicited ECPs may be generated by the contractor, field activities, or fleet commands. Prior to requesting a formal ECP, the requester must carefully evaluate all ramifications of the change, including:

1. The relative merit of the proposed change versus no change.
2. The work hours, downtime, technical competence, and level or type of facilities required to accomplish the change.
3. The man-hour backlog to incorporate already approved changes.
4. The effect on spares, repair parts, existing retrofit kits, data, and publications.
5. The effect on delivery schedules.
6. The effect upon human factors, personnel training, training equipment, and training devices.
7. The effect on existing support equipment (SE) and test equipment or the need for design, development, and procurement of new SE.
8. The availability of funds.
9. The safety risk assessment of hazard severity and probability of occurrence. Risk assessment results in a classification of either Category I (catastrophic) or Category II (critical).

Change proposals are evaluated in terms of outcome. Do they (1) correct deficiencies, (2) make a significant effectiveness change, (3) effect a substantial life cycle cost savings, (4) prevent slippage in an approved production schedule, or are they (5) identified as value engineering change proposals (VECPs)? VECPs are the result of a review designed to identify potential cost savings measures. Special consideration is given to those changes identified as safety changes (Code S) that have been identified as Category I or II hazardous conditions.

An ECP is received by AIR-1022B (Configuration Management/Aircraft Modification Division) and routed through the Change Control Board (CCB) secretariat for recording and distribution to the cognizant NAVAIR headquarters group or program management office, which may accept the change and issue a decision memorandum (DM) or decline the change in writing, stating its reasons for denial. Once a DM is received by the action codes, they begin a detailed

evaluation of the proposed change and prepare the required CCB change request forms, implementation schedules, and financial summaries. The cognizant AIR-05 Assistant Program Manager (Systems & Engineering) (APM (S&E)) or the cognizant design engineer and cognizant AIR-04 Assistant Program Manager, Logistics (APML) are responsible for directing the review and evaluation of ECPs. Concurrent evaluation takes place within AIR-05 and AIR-04.

AIR-04 Processing

AIR-4113 is the central receiving point for ECPs within AIR-04. It coordinates review among AIR-04 groups to ensure that each proposed change is evaluated by all affected AIR-04 codes. The APML conducts a preliminary review to determine whether affected fleet support areas are adequately addressed. If so, the cognizant AIR-04 agent will be notified so a DM can be expedited. The APML then staffs the proposed change and coordinates with AIR-05 counterparts, affected AIR-04 codes, and support activities. A cost and funding summary and a milestone chart are prepared with input from the support activities. Each change to a weapons system must be adequately supported at the time the first changed items reach the fleet. Unsupportability is grounds for disapproval of an ECP.

A minimum of 120 calendar days from receipt of an ECP at NAVAIR headquarters is normally required to process and implement routine priority ECPs.

AIR-04 ECP QMB ACTIVITIES

The AIR-04 ECP QMB first began meeting and documenting the ECP process at the end of September 1988, although the formal charter was not dated until November and not received by the QMB until March 1989 (Appendix C). Difficulties in convening the QMB arose in December and January because the Chair was involved in a contract source selection evaluation and was away from AIR-04 for lengthy periods of time.

Two-Phase Strategy for Process Improvement

A two-phase process was endorsed by the AIR-04 Group QMB (formerly the AIR-04 ESC) for process improvement. First, the ECP QMB would identify and remove special causes, or those causes of variation that can be addressed by the workers in the process, for example, waste and complex procedures. Secondly, it would identify common causes, or those variations within the process that can be addressed only by management, and implement changes to improve the system. This two-phase strategy is endorsed by both Deming and TQM proponents, that is, bring the system into statistical control by eliminating special causes before introducing system changes.

The ECP QMB initially tried to review the ECP process for aircraft, engines, missiles, and components. Its charter specifically defines the process as one that spanned "NAVAIR

receipt of the ECP to NAVAIR approval of the change; concentration will be on that portion of the process that goes thru [sic] AIR-04." The QMB's charter identified excessive lengths of time for AIR-04 ECP approval as the problem, but specific time goals were not established.

The QMB found that review of the entire ECP process was too broad in scope and encompassed too many variables. The facilitator helped the Board to begin thinking in a narrower vein and to focus its efforts on just one component of the process. The members reduced the scope of their vision to airframe change proposals, which represent the greatest percentage of the modification budget. They also reduced the time frame to that period bounded by receipt of the ECP by AIR-04 to approval of the cost/funding summary and milestone chart (CF/MS).

Preliminary Data Analysis

The QMB spent some time identifying the process. They identified people, machines, methods, materials, environment, input, and output. The process customers and managers and expectations of each were identified, as were key individuals (Appendix D). During this phase, members reviewed all pertinent instructions, reviewed the aircraft modification (MOD) process training material, conducted interviews with AIR-04's mini-Change Control Board (CCB) members, observed some CCB meetings, and attended operational, safety, and improvement program (OSIP) training. Following that data collection effort, the QMB briefed the AIR-04 Group QMB.

The Board collected and analyzed time data from the AIR-04 Modification Management Information System (MODMIS) data base, ECP status sheets, and OSIP training course test results. In addition, they conducted structured interviews with APMLs, logistics managers (LMs), and logistic element managers (LEMs). The interview questions are listed in Appendix E.

The last five ECPs to exit the system each month between October 1984 and March 1989 were selected as the sample base from which to collect historical time data; that is, the number of days expended from receipt of the program manager's DM to approval or disapproval of the ECP. Means and ranges were computed for each month's data and plotted on a run chart. Visual examination of these data revealed four "high" spikes. Further investigation indicated these "spikes" were caused by ECPs that had been cancelled or disapproved without prejudice, but were not removed from the MODMIS.

The QMB informed the Configuration Management and Aircraft Modification Division (AIR-102) of these data entry problems; AIR-102, in turn, implemented a formal process change to the MODMIS. This change requires all program managers to review open ECPs on a regular basis and to provide an action plan for all ECPs that exceed the planned CCB dates. This should result in reducing the mean time ECPs remain in the approval process, including the time spent in AIR-04. However, it is dependent on the program managers' responsiveness in updating the

information sent to AIR-102. This step is consistent with initial process analysis procedures, whereby a process may be "cleaned up" when obvious complexities or redundancies become evident.

After the four "spiked" data points were removed from the data base, new monthly means, ranges, and control limits were computed. These data are displayed in Table 1. The complete control chart can be found in Appendix F.

Table 1
Comparison of Run Chart Data

	Days	Range
Mean Time	89/85 ^a	145/127 ^a
UCL ^b	158	269
LCL ^b	12	0

^a Before change/After change.

^b The upper control limit (UCL) and lower control limit (LCL) were not computed until the "spiked" data were removed.

A second problem surfaced very early in the data-gathering stage. ECPs have approval channels in both AIR-04 and AIR-05; however, AIR-05 did not use the AIR-04 MODMIS data base to track the ECP process. Therefore, it was impossible for AIR-04 to know whether a delay was in AIR-04 or in AIR-05.

This problem had also been addressed by NAVAIR's Acquisition Improvement Team (established before the current TQM implementation effort and still in place). As a result of the work of these two groups, a recommendation was made to make AIR-04's MODMIS the NAVAIR standard data base to be used by all NAVAIR groups and commands. This was mandated by VADM J. B. Wilkinson (Commander, NAVAIR) in Acquisition Bulletin #11, dated 9 May 1989. This standardization will streamline the process and aid in identification of systemic problems.

These two examples readily identify the types of special causes that can be corrected, resulting in reduced waste and a streamlined process. Coordination and implementation of the recommendations were accomplished with minimal difficulty because of those members who link AIR-04's QMB and NAVAIR's ECP QMB.

Identification of Common Causes

From the flow charts developed, the AIR-04 ECP QMB was able to identify areas where concurrent review of the ECP could take place, notably, between Support Equipment Logistics Management Division (AIR-417) and Support Equipment Division (AIR-552) (Appendices G and H). This constitutes a change to the process, not elimination of a special cause. The basic thrust for this effort is to bring AIR-552 directly into the AIR-04 ECP process, similar to all other elements of Integrated Logistics Support (ILS), which should reduce processing time within AIR-417. To measure its effects, the Board will collect new historical baseline data through implementation of the change. This new data will help the Board measure both the effects resulting from elimination of special causes and from system changes.

CONTINUING EFFORTS

Establishment of a Process Action Team (PAT)

Using NPRDC's process improvement model as a guide, the AIR-04 ECP QMB chartered a Process Action Team (PAT) in August 1989. A candidate for the PAT Chair was proposed by the QMB Chair and was ratified by the QMB members. Although the Chair does not currently work in the process, selection was based on the candidate's knowledge and previous experience with the ECP process. The Chair also is a former member of AIR-04's CCB. Individual PAT members were selected by the PAT Chair.

Initial responsibilities of the PAT are to validate the data received in the interviews conducted by the QMB. They will also review recently approved CCB cost and funding and milestone charts to determine if comments made regarding quality and executability of ECPs are valid. They will define criteria by which each ECP should be judged. These recommendations will be reviewed by the QMB. However, the main thrust of the PAT will be to evaluate and improve AIR-04's ability to implement changes once approved.

Identification of Other ECP-Related Issues

Using the Hertz Group exercise for customer identification, the QMB identified customers and managers and their expectations. They then ranked the expectations in order of priority. In doing this, they discovered that timeliness, the problem they were working on, had the lowest priority, ranking fifth in a group of five expectations. It was preceded by the need for clear, implicit instructions (#4); for complete and accurate ECPs received from the contractor (#3); for ECPs that meet the requirements (#2); and for ECPs that are executable, both financially and in terms of scheduling (#1). In a brainstorming session, the QMB developed a list of 10 actions that contribute to an ECP that fully meets all five expectations. From that list, they identified which ones supported each of the five expectations and rank-ordered them for each of the five expectations.

It became apparent to the AIR-04 ECP QMB that concentrating on timeliness was too narrow a focus. The QMB feels the more important issues are those that contribute to an accurate, "doable" ECP. These issues are:

1. Improved training in the planning and preparation of CCB documentation.
2. Reviewing for correctly formatted ECPs submitted to AIR-04.
3. AIR-04 OSIP coordination.
4. Current processing within divisions, for example, PMA-205.
5. Improved coordination between common system and aircraft personnel.

Concentrating on those issues should result in less rework and should also reduce time from receipt to approval.

New measurement characteristics are being explored by the QMB to determine how to measure changes in dimensions other than time. This leads the group directly into the next round of the PDCA cycle, central to NPRDC's concept of continuous improvement.

CONCLUSIONS AND RECOMMENDATIONS

Process Definition

In the beginning, the ESC had little guidance or directions for proceeding, nor did it have an external facilitator to help it begin the implementation process. Although this may pose problems, the experience seems to be typical and may be a necessary part of the implementation process. Perhaps only after some months of learning about TQM theory and its application to the daily work processes can serious implementation efforts get underway.

The AIR-04 ECP QMB charted new waters. It was the first QMB chartered by AIR-04 or by NAVAIR. As such, there was little profound knowledge available to aid members in this undertaking. Their charter stated that they should review the process from receipt of the ECP at NAVAIR to the approval or disapproval of the ECP, with emphasis on the AIR-04 functions. This was a false start because the entire process is much too large and complex to be readily analyzed at one time. Once this was recognized, the Board concentrated on only one type of ECP, airframe. NAVAIR's ESC also addressed the problem of dealing with a large complex process and subsequently established Group QMBs to oversee the entire system, with lower-level QMBs established for particular areas.

Work Prioritization

Management must address work prioritization. Initially, TQM team (ESC/QMB/PAT) work may require substantial amounts of time for implementation efforts to be successful. People may need to be excused from other responsibilities to meet the TQM implementation requirements. As TQM is fully integrated into the workplace as a management philosophy, there should be fewer problems associated with work priority.

Education and Training

Members expressed concern about being selected for a QMB before receiving adequate training. They did not think the 1-day awareness and 1-day implementation seminars conducted by NPRDC provided sufficient training to understand fully their roles as QMB members.

The AIR-04 QMB facilitator attended three TQM training sessions, including a Deming 4-day seminar, before attending facilitator training. This was considered optimal by the facilitator. He felt the "light turned on" during that fourth training session, and he could readily see the applicability of TQM to the Department of Defense environment. He noted that some people in his class had not received a firm foundation in TQM before going to the facilitators' course.

Just-In-Time (JIT) is a concept that should be used in planning training so that training occurs at a time when it is most useful. For example, training should precede assignment to a particular role, such as membership on a QMB or PAT.

These issues can only be addressed by management. Monitoring the TQM training received by each employee and ensuring that the proper sequence of courses is followed are ongoing management tasks.

Emphasis on Immediate Results

Understandably, NAVAIR and AIR-04 are anxious to be on-board with TQM and to make measurable improvements to their processes in support of customer requirements. At the same time, too much emphasis on bottom line or measurable process improvement led QMB members to express a fear that nothing had changed. They felt pressure to produce "something."

Process improvement is an ongoing, long-term effort. Certainly, as people become more familiar with the TQM tools and methodology, front-end activity will proceed more smoothly and results may be evident earlier. However, in these first efforts, heavy emphasis on rapid change of the process does not foster TQM thinking.

Documentation

The Air-04 ECP QMB charter includes a directive to write a case study of its process improvement effort. This report is the first installment and is the result of close collaboration between the AIR-04 ECP QMB and NPRDC. For future documentation, the QMB should select a secretary or recorder to maintain a record of actions taken. The official record should include all flow charts, diagrams, statistical computations, control charts, etc., that are completed for the process. These are important tools for tracking completed work.

In summary, AIR-04 and the ECP QMB have done an admirable job implementing TQM. Two special causes were identified and changes implemented to prevent their reoccurrence, thus streamlining the overall process. A system change was also implemented, involving the concurrent review of documents by AIR-417 and AIR-552, a change that should have a positive impact on the time it takes AIR-04 to approve an ECP. Data to support that assumption will be collected over the next few months.

AIR-04 has plotted a new course and demonstrated great commitment to pursuing continuous improvement. False starts and unpredictable delays will undoubtedly occur along the way; however, the lessons learned will be invaluable in the continuing TQM effort.

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- Houston, A., & Dockstader, S. L. (December 1988). *A total quality management process improvement model* (NPRDC Tech. Rep. 89-3). San Diego: Navy Personnel Research and Development Center.
- Metz, E. J. (Summer 1984). Managing change: Implementing productivity and quality improvements. *National Productivity Review*, 3, 303-314.

APPENDIX A
ECP QMB MEMBERSHIP

(A-0)

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APPENDIX A

ECP QMB MEMBERSHIP

Paul Kovalsky, AIR-411A (Chair)

Bruce Doubleday, Facilitator

Jerry Beck, AIR-4104

Keric Hopkins, AIR-41831F

Marlene Montilla, AIR-410C

Paul Ritter, AIR-55211

Robert Schultz, AIR-41223A

Ginger Toucher, AIR-41723

Ed White, AIR-433A

Cindy Taylor, Logistics Intern

Mike Taylor, Logistics Intern

APPENDIX B
DEMING'S 14 PRINCIPLES OF MANAGEMENT

(B-0)

VIII-63

DEMING'S 14 PRINCIPLES OF MANAGEMENT

1. Create constancy of purpose towards improving products and services, allocating resources to provide for long-range needs rather than short-term profitability.
2. Adopt the new philosophy for economic stability by refusing to allow commonly accepted levels of delays, mistakes, defective material, and defective workmanship.
3. Cease dependence on mass inspection by requiring statistical evidence of built-in quality in both manufacturing and purchasing functions.
4. Reduce the number of suppliers for the same item by eliminating those that do not qualify with statistical evidence of quality; end the practice of awarding business solely on the basis of price.
5. Search continually for problems in the system to constantly improve processes.
6. Institute modern methods of training to make better use of all employees.
7. Focus supervision on helping people do a better job; ensure that immediate action is taken on reports of defects, maintenance requirements, poor tools, inadequate operating definitions, or other conditions detrimental to quality.
8. Encourage effective, two-way communication and other means to drive out fear throughout the organization and help people work more productively.
9. Break down barriers between departments by encouraging problem solving through teamwork, combining the efforts of people from different areas such as research, design, sales, and production.
10. Eliminate use of numerical goals, posters, and slogans for the work force that ask for new levels of productivity without providing methods.

11. Use statistical methods for continuing improvement of quality and productivity, and eliminate work standards that prescribe numerical quotas.

12. Remove all barriers that inhibit the worker's right to pride of workmanship.

13. Institute a vigorous program of education and retraining to keep up with changes in materials, methods, product design, and machinery.

14. Clearly define top management permanent commitment to quality and productivity and its obligation to implement all of these principles.

APPENDIX C
NAVAIR QMB CHARTER

(C-0)

VIII-67

NAVAIR Quality Management Board (QMB)
Charter# 04-01

The following QMB is officially chartered by AIR-04 GRP QMB to work on the following process using Total Quality Management (TQM) techniques and methodology:

Process Description:

Engineering Change Proposal (ECP) process from NAVAIR receipt of the ECP to NAVAIR approval of the change; concentration will be on that portion of the process that goes thru AIR-04. Problems seem to be the length of time it takes for ECP's to get approved.

Date of Commencement November 1988

Chairperson Paul Kovalsky Code AIR-411A Phone 692-3212

Board Members (name/code)

Jerry Beck/4104	Ed White/433A
Marlene Montilla/410C	Paul Ritter/55211
Robert Schultz/41223A	Mike Taylor/Intern
Kerry Hopkins/418	Ginger Toucher/41723

Resource Sponsor (upper link-pin) Paul Harner Code 04A Phone 692-2690

Facilitator Mr. Bruce Doubleday Code 4183 Phone 692-8182

Reviewing Authority AIR-04 GRP QMB

Last Review 2/14/89

This QMB is linked to the following QMB 00-02 Link-pin Paul Kovalsky

In the execution of this assignment, the QMB is authorized to charter one or more Process Action Teams (PAT) to collect data and assist in analysis requirements. The following PAT's are active:

PAT#1 Date Commenced _____ Chairman _____ Code _____
Phone _____

PAT#2 Date Commenced _____ Chairman _____ Code _____
Phone _____


Reviewing Authority

(C-1)

APPENDIX D
AIR-04 ECP PROCESS
AS DEFINED BY THE QMB

(D-0)

**AIR-04 ECP PROCESS
AS DEFINED BY THE QMB**

Process Boundaries/Title:

Start Point: Receipt of ECP in AIR-04 (410C)
End Point: CCB Board Decision
Process Title: AIR-04 Aircraft ECP Process

Process People:

AIR-410C APMLs
AIR-433 AIR-412
AIR-417 AIR-552
PMA-205 NATSF
ASO

Process Machines:

MODMIS (Computer)
Typewriters/Word Processors
Copy Machines
Calculators

Process Methods:

Matrix Review/Sign-off
Control Board Review/Approval
Matrix Routing
Configuration Control Manual (4130.1B)
MODMIS Program Software
MIL-STD-480

Process Materials:

Forms: 13050/2 (CCB MAT)
 13050/2C (Change Requirement for SE)
 13051/3 (C&F Summary)
 13051/5 (Milestone Chart)

PMA Decision Memo
APML Implementation Letter
TYCOM Approval Letter/Form

Process Environment:

High Density Office Space
High Individual Workload
Limited Staffing
Competing Priorities
Travel Commitments
CWS

(D-1)

Poor Internal Routing/Mail System
Diverse Physical Locations of Reviewers (i.e., ASO)
Limited Conference Room Space
Limited Storage Space

Process Input:

Receipt of ECP
Decision Memo from PMA

Process Output:

CCB Approval/Disapproval
Completed Form 13051/3 (C&F)
13051/5 (Milestones)
TYCOM Concurrence
Implementation Assignments

Process Statement:

Title: AIR-04 Aircraft ECP Process

Components: People
Materials
Machines
Environment
Methods

Input: Receipt of ECP/PMA Decision Letter

Output: LEMs Products into CCB Formats

Value Added: Screens out/Resolves:

Technically Unsound ECPs
Unsupportable ECPs
Nonaffordable ECPs

Ensures:

Identification of Required Resources
Identification and Assignment of Implementing Actions

Process Customers (i.e., customers who are going to have to do something; they will receive an action item, not a finished product):

PMA
APML
PCO/ACO
Class Desk
AIR-514
AIR-102
AIR-552/417
PMA-205

ASO
NATSF
AIR-412
AIR-43/NADOC/NAMO

Process Managers:

APMLs
AIR-412
PMA-205
AIR-552/417
ASO
NATSF
AIR-410C
AIR-43/NADOC/NAMO

Customer Expectations:

	<u>PRI</u>
Requirement (meets a need)	1
Decision (approval)	2
Accurate	2
Complete	4
On time (CCB Date)	5

Manager Expectations:

	<u>PRI</u>
Decision	1
Accurate	1
On time (CCB Date)	3
Complete	3
Executable (funding)	3

Key Individuals:

APMLs
AIR-410C
AIR-412
AIR-552/417
PMA-205
ASO
NATSF

Measurement Characteristic:

Time

APPENDIX E
INTERVIEW QUESTIONS

(E-0)

VIII-77

INTERVIEW QUESTIONS

1. What is your involvement in the OSIP [operational, safety, and improvement program] process and planning for ECP processing in general?
2. What are your procedures for processing ECPs? Please discuss the following:
 - a. ECP planning/coordination meetings with PMA, Class Desk, Prime Contractor, and Field Activities.
 - b. Preparation of Cost & Funding and Milestone charts.
 - c. ECP routing and chops through AIR-04.
 - d. Interface with LM/LEMs for processing ECPs (ECP team meetings).
3. How do you track status of ECPs from receipt through implementation?
4. How does ECP processing fit with your priority of workload?
5. What would you recommend we do to improve the ECP process?

APPENDIX F
CONTROL CHART

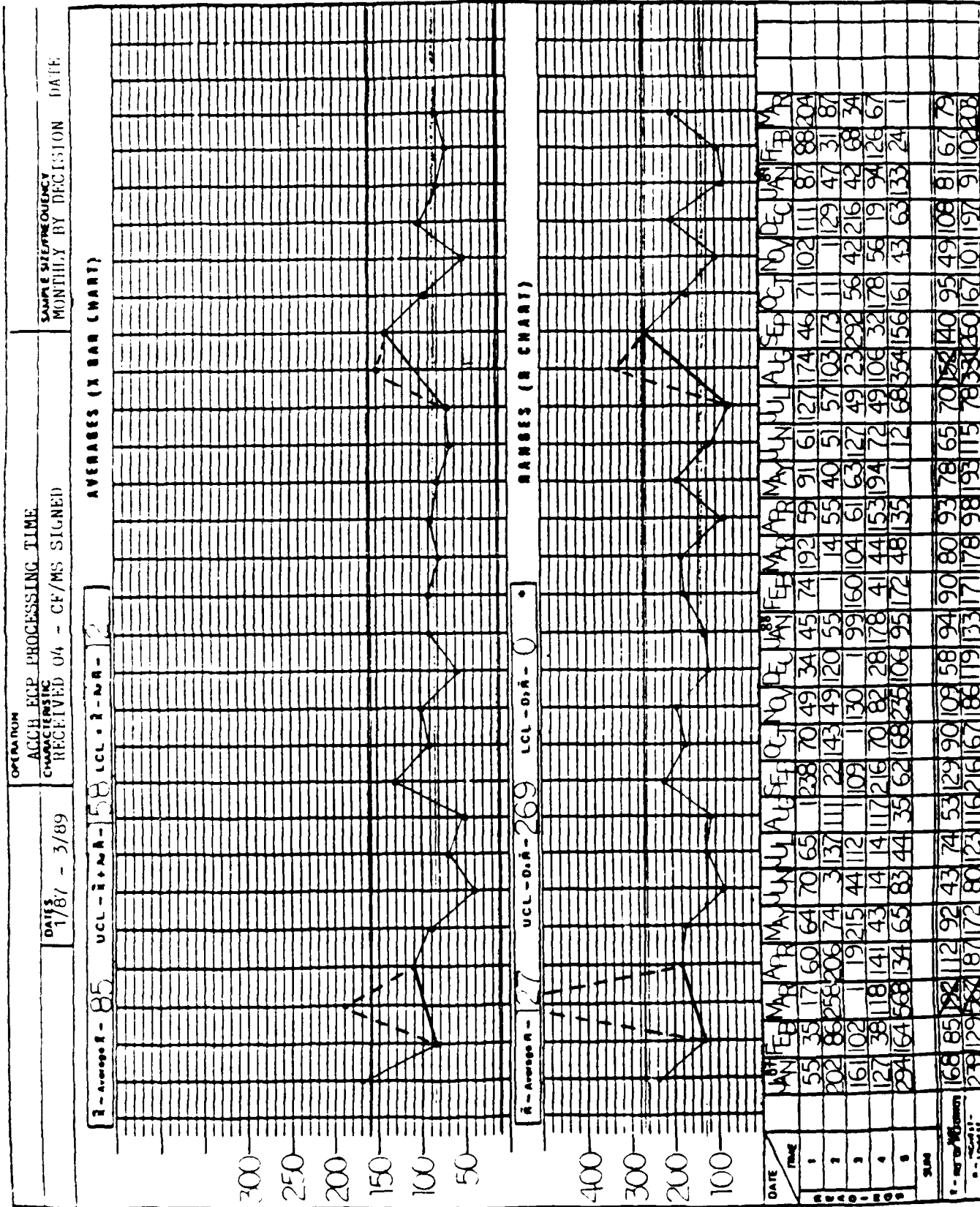
(F-0)

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CONTROL CHART

[illegible]

CONTROL CHART



APPENDIX G
ECP FLOW CHARTS

(G-0)

VIII-85

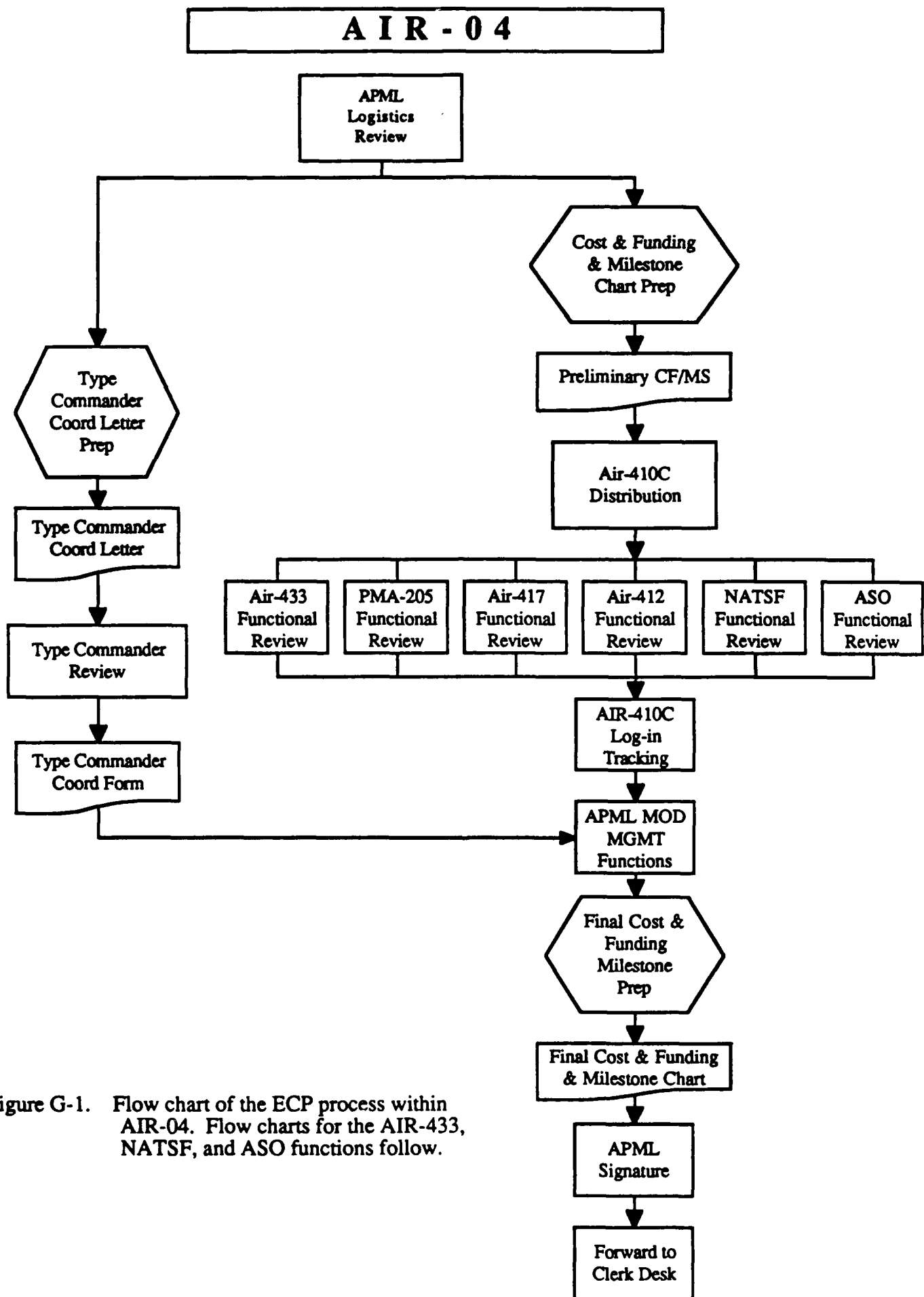


Figure G-1. Flow chart of the ECP process within AIR-04. Flow charts for the AIR-433, NATSF, and ASO functions follow.

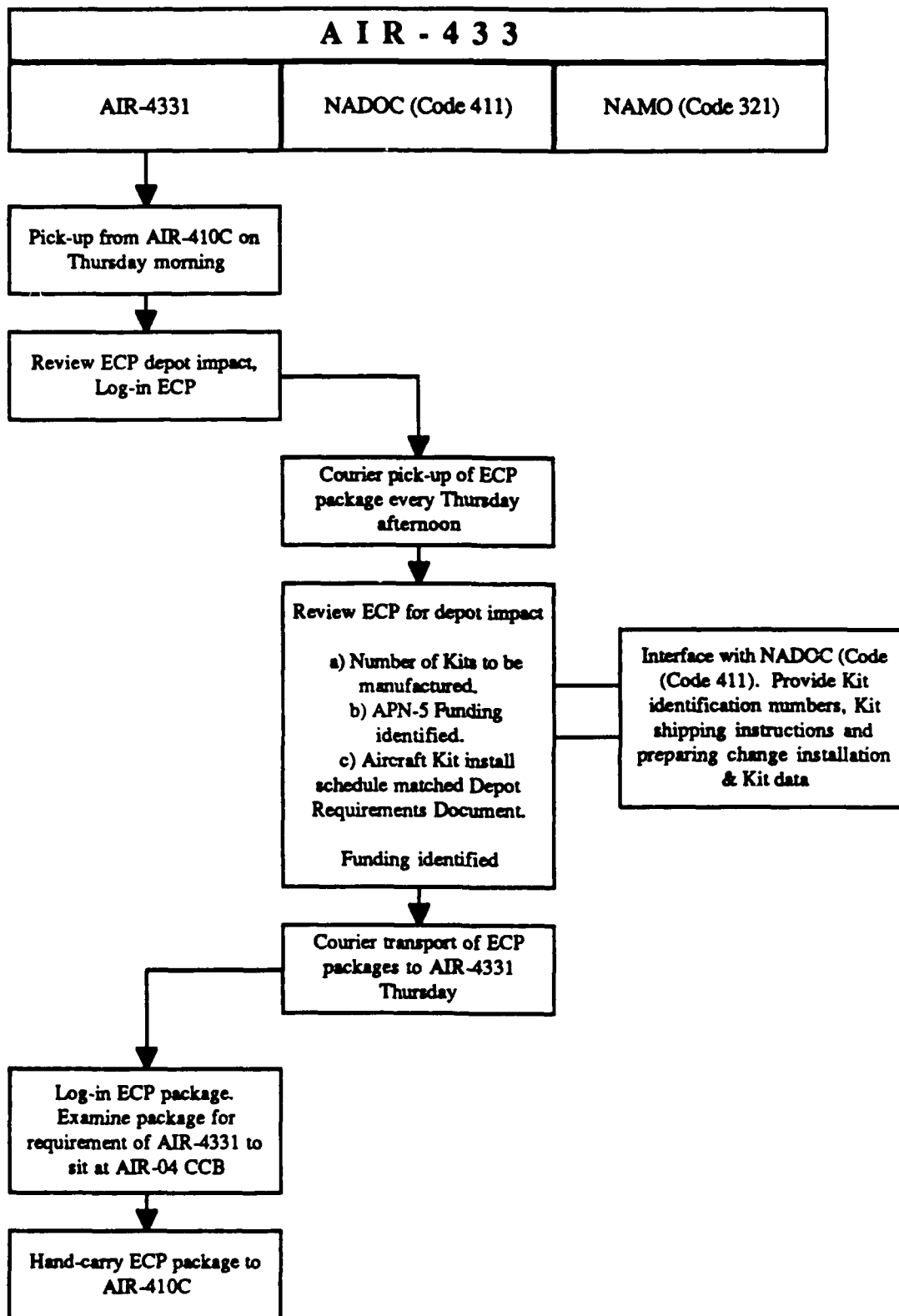


Figure G-2. Flow chart for the AIR-433 function.

(G-2)

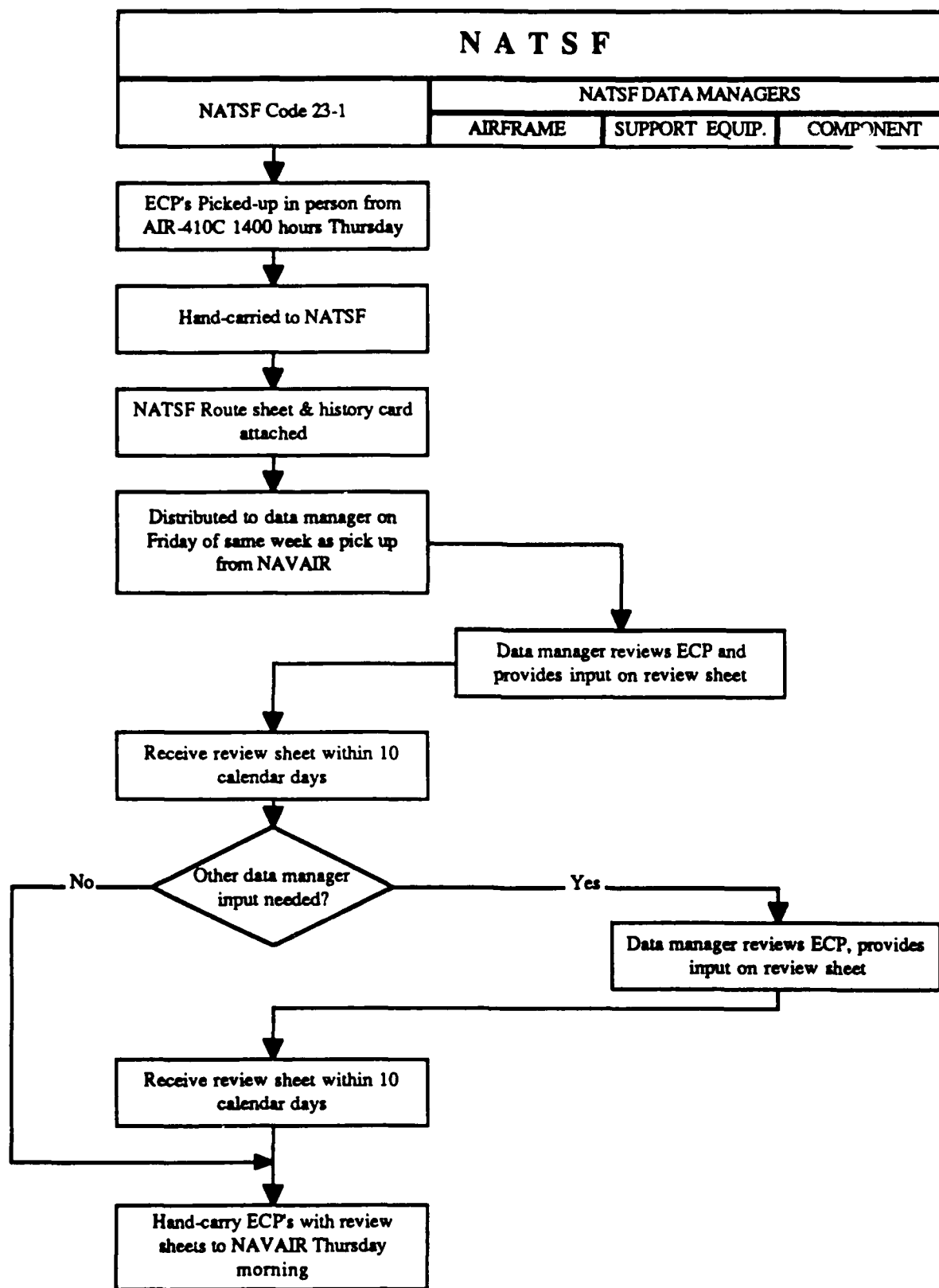


Figure G-3. Flow chart for the NATSF (Naval Aviation Technical Service) function.

(G-3)

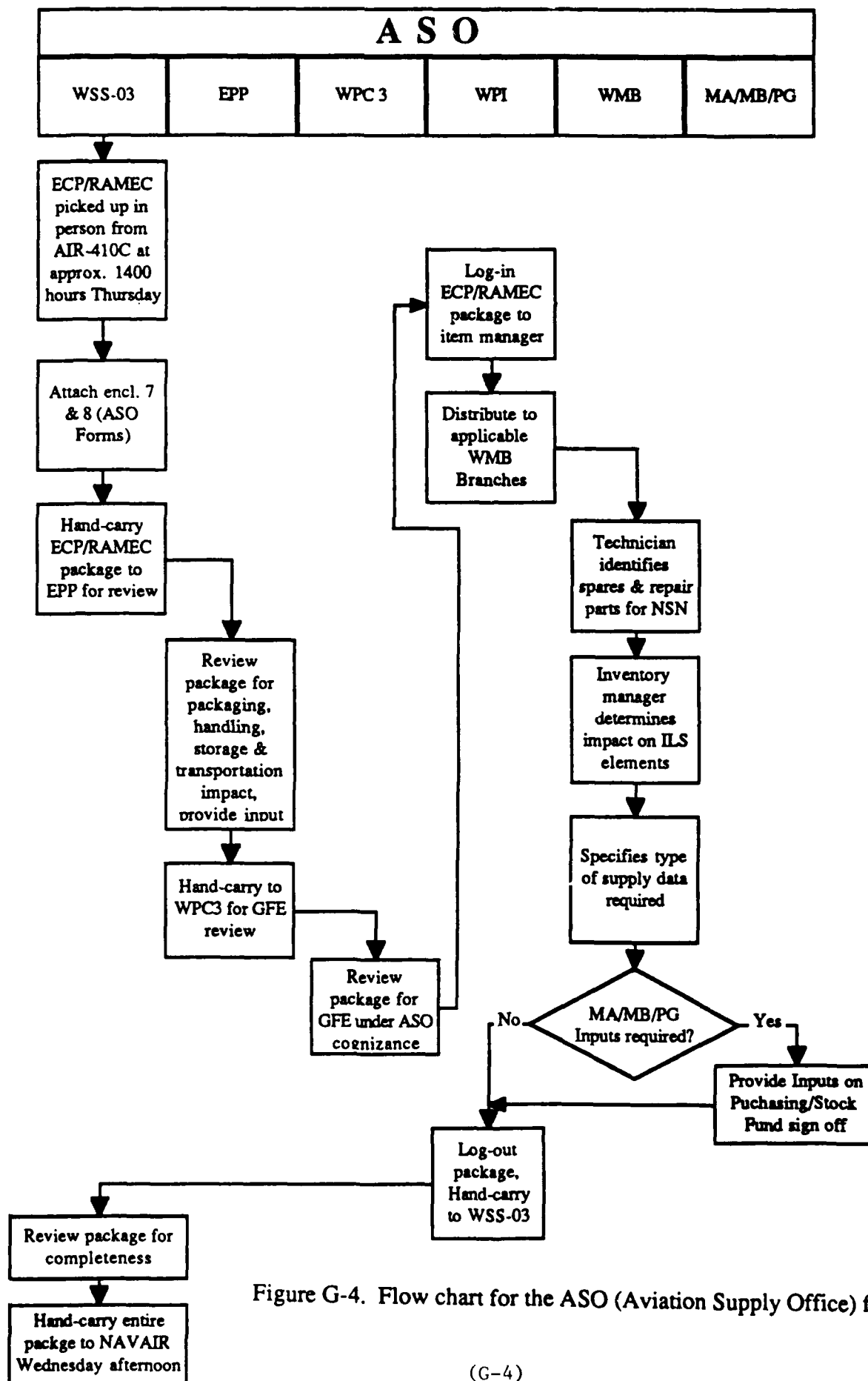


Figure G-4. Flow chart for the ASO (Aviation Supply Office) function.

(G-4)

APPENDIX H

SUPPORT EQUIPMENT PROGRAM
MEMORANDUM OF AGREEMENT (SEPMOA)

(H-0)

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SUPPORT EQUIPMENT PROGRAM MEMORANDUM OF AGREEMENT (SEPMOA)

From: AIR-417/AIR-552

Subj: SUPPORT EQUIPMENT PROGRAM ENGINEERING CHANGE PROPOSAL
PROCESSING; POLICY, PROCEDURES AND RESPONSIBILITIES FOR

Ref: (a) NAVAIRINST 4130.1B
(b) NAVAIR Manual 00-25-300

Encl: (1) AIR-417/AIR-552 ECP Flow Diagram (Overview)

1. Purpose. This SEPMOA establishes policy and procedures for the processing of Engineering Change Proposals (ECPs) between AIR-552 and AIR-417 prior to submission to the Change Control Board and in accordance with references (a) and (b).

2. Background. Currently ECPs are parallel routed from AIR-410C through other AIR-04 codes such as AIR-418, AIR-412 and AIR-417. To date, AIR-552 has not been included in this routing procedure. Since AIR-552 is the Logistics Element Manager for SE for AIR-410, the inclusion of AIR-552 in the routing vice AIR-417 would provide the Acquisition Manager information, such as the Cost and Funding and Milestone Charts, on which to base SE acquisition decisions for the respective modification.

3. Scope. This SEPMOA applies to all aircraft, component, and engine ECPs which are processed through NAVAIR, excluding RAMECs.

4. Policy. AIR-552 and AIR-417 are responsible for timely and effective processing of ECPs that are routed through the NAVAIR organization. They ensure that essential support functions and tasks are identified, approved and funded in a consistent and systematic manner.

5. Definitions. The following definitions apply:

a. Functional Acquisition Managers (AMs)--Individuals in AIR-552 with specific functional/commodity/program element area acquisition management responsibilities for SE.

b. Weapon System Assistant Program Manager Logistics (APML)--Individuals in AIR-04 with overall systems integrated logistics support responsibility for a given weapon system.

c. APML/Logistics Manager (APML/LM)--Individuals in AIR-417 with integrated logistics support management responsibilities for SE, whether they are commodity managers or program element managers.

d. Support Equipment Project Officers (SEPOs)--Individuals in AIR-552 with responsibility to manage the overall support equipment program for a given weapon system.

e. Avionics Support Officers (ASPOs)--Individuals in AIR-552 with responsibility to manage the avionics support equipment program for a given weapon system.

f. Configuration Manager (CM)--Individuals in AIR-417 and AIR-552 with responsibility as focal points for all ECPs processed in their respective codes. They are the AIR-417 and AIR-552 representatives to the CCBs. AIR-552CM will attend the AIR-04 "mini-board" prior to the afternoon CCB in order to sustain continuity of information flow and report on status of 05 ECPs.

6. Procedures/Responsibilities: Within the guidelines of references (a) and (b), and expanding on the enclosure (1) overview, the following procedures will apply:

a. AIR-552 will replace AIR-417 in the routing chain from AIR-410C which is in concert with the established Logistics Element Manager (LEM) concept.

b. AIR-552 CM will receive the ECP copy that contains the cost and funding (C&F) and milestone (MS) pages prepared by AIR-410 APML.

c. AIR-552 CM will log in ECP and staff the ECP through the applicable AM/SEPO/ASPO for a given system.

d. The AIR-552 AM/SEPO/ASPO will concur on the C&F/MS or make necessary changes and prepare the NAVAIR 13050/2C sheet, which identifies the costs associated with the acquisition/modification of SE, if SE impact is identified. Upon completion of the NAVAIR 13050/2C sheet, the AM/SEPO/ASPO will attach it to the ECP and forward the ECP to the AIR-552 CM, notating the proper routing on the route sheet of the applicable AIR-417 APML/LM.

e. The AIR-552 CM will log-out the ECP to the AIR-417 CM and hand carry the package, including the NAVAIR 13050/2C sheet, to the AIR-417 CM.

f. The AIR-417 CM will log-in the ECP and staff through the annotated codes on the route sheet. If more than one code is necessary for staffing, (i.e., more than one piece of SE), the AIR-417 CM will make copies of the route sheet, ECP cover sheet, C&F/MS and parallel route to AIR-417 codes. The AIR-417 CM will retain complete ECP package. If only one AIR-417 code is on route sheet, the AIR-417 CM will log in the ECP and hand carry ECP package to proper APML/LM.

g. The applicable AIR-417 APML/LM will staff the ECP, providing logistics input on the SE as outlined by the NAVAIR 13050/2C sheet. This will include inputs from field activities and LEMs, if required.

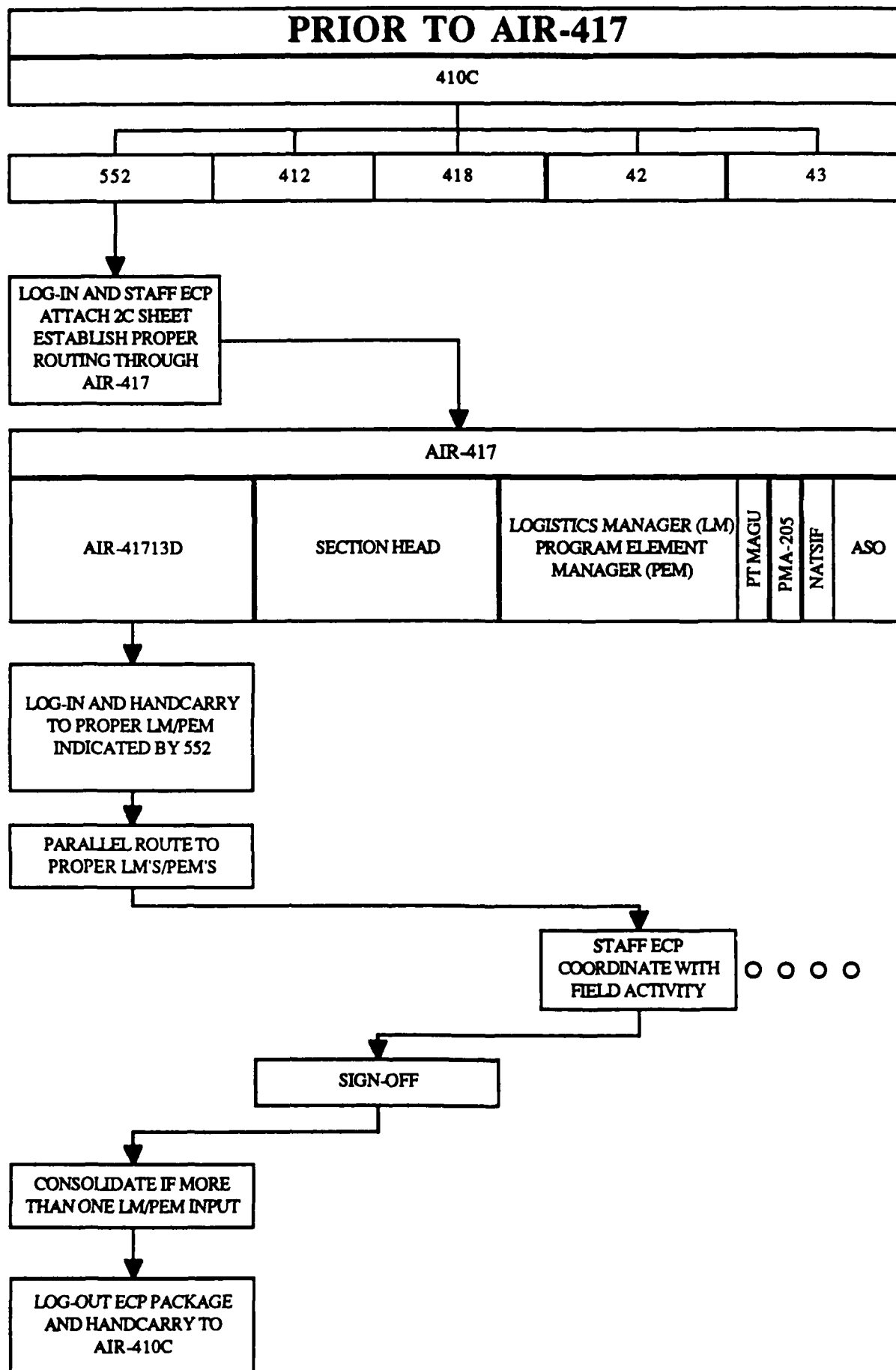
h. After staffing is complete, the AIR-417 APML/LM will return the package to the AIR-417 CM, who will consolidate the inputs for the parallel routed ECPs on the master ECP, log-out and hand carry the consolidated package to AIR-410C. For ECPs that are not parallel routed, the AIR-417 CM will log-out the package and hand carry to AIR-410C.

T. W. Rogers
Cdr, USN

C. R. Munsey
Capt, USN

(H-2)

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